

2010 Edition

**Construction
Management**

Standards of Practice

CMAA

Construction Management Standards of Practice

2010 Edition



**Advancing Professional Construction
and Program Management Worldwide**

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Acknowledgements

Mark Berry, Esq., Peckar & Abramson
Ray Brady, CCM, MWH Global
Gary Cardamone, Port of Long Beach
David Carter, CCM, Atkins
Dave Conover, CCM, HDR, Inc.
Ted Devins, Parsons Brinckerhoff
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Soad Kousheshi, PE, A/E/C Strategy, Inc.
Judith Kunoff, AIA, CCM, LEED AP, MTA New York City Transit
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Preface

Construction Management Standards of Practice is intended to establish industry standards of service and to serve as a guide to the range of services that constitute professional Construction Management. By issuing this document, CMAA seeks to define Construction Management services without limiting the methods and procedures by which a professional CM may provide those services for a particular project or program.

The scope and types of services a CM actually provides to a specific project or program may vary from those described in this document. This document is intended to provide a menu of services: Not every project/program will require every service, and a particular project/program may require unique services not listed in this document. Whatever service is provided, this document prescribes an industry standard of practice, which the CM will meet or exceed. CMAA does not intend that this document be used by courts or others to create contractual or legally enforceable duties or requirements, as such duties and requirements are established by terms of the CM's contract and the laws of the jurisdiction in which the CM is practicing. The *Construction Management Standards of Practice* is related to the Standard Forms of Agreement and Contracts published by CMAA. The standard services may change to the extent the provisions of such agreements are modified or altered.

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Development of this document involved participation by a broad spectrum of the Association's membership. Input was gratefully received from industry groups other than CMAA.

Construction Management Standards of Practice is an evolving document, open to scrutiny and critique by the industry. The publication of the 2009 edition of *Construction Management Standards of Practice* reflects that intention. CMAA's leadership is committed to updating and refining the manual to meet the changing needs of CMs and their clients in the years to come.

Code of Professional Ethics

Since 1982, the Construction Management Association of America (CMAA) has taken a leadership role in regard to critical issues impacting the CM industry, including setting ethical standards of practice for the Professional Construction Manager.

The CMAA Board of Directors has adopted the following *Code of Professional Ethics of the Construction Manager* and recommends that it be accepted and supported by the CM industry and the membership of the CMAA as a guide to the execution of the individual CM's professional duties.

Corporate and individual practitioner members of Construction Management Association of America make a commitment to conduct themselves and their practice in accordance with the Code of Professional Ethics of the Construction Manager.

Code of Professional Ethics of the Construction Manager

As a professional engaged in the business of providing Construction Management services, and as a member of the CM profession, I agree to conduct myself in my business in accordance with the following:

1. **Client Service.** I will serve my clients with honesty, integrity, competence, and objectivity, establishing a relationship of trust and confidence and furnishing my best skills and judgment consistent with the interests of my client.
2. **Representation of Qualifications.** I will only accept assignments for which I am qualified by my education, training, professional experience and technical competence, and I will assign staff to projects in accordance with their qualifications and commensurate with the services to be provided.
3. **Standards of Practice.** I will furnish my services in a manner consistent with the established and accepted standards of the profession and with the laws and regulations which govern its practice.
4. **Fair Competition.** I will build my professional reputation on the basis of my direct experience and service provided, and I will compete fairly and respectfully with my professional colleagues.
5. **Conflicts of Interest.** I will seek to avoid any and all conflicts of interest and will immediately acknowledge any influences and offer to withdraw from any assignment when any actual conflict exists which may impair my objectivity or integrity in the service of my clients.
6. **Fair Compensation.** I will negotiate fairly and openly with my clients in establishing a basis for compensation, and I will charge fees and expenses that are reasonable and commensurate with the services to be provided and the responsibilities and risks to be assumed.
7. **Release of Information.** I will release public statements that are truthful and objective, and I will keep information and records confidential when appropriate and protect the proprietary interests of my clients and professional colleagues.

8. **Public Welfare.** I will not participate in any racial, sexual or political discrimination related to any assignment I may undertake. I will avoid any conduct that would be considered unethical or will interfere or conflict with any laws, statutes or regulations, and I will uphold the safety, health and welfare of the public in the performance of my professional duties.
9. **Professional Development.** I will continue to develop my professional knowledge and competency as a practitioner, and I will contribute to the advancement of CM practice as a profession by fostering research and education and through the encouragement of subordinates and fellow practitioners.
10. **Integrity of the Profession.** I will avoid actions which promote my own self-interest at the expense of the profession, and I will uphold the standards of the Construction Management profession with honor and dignity.

Chapter 1: Introduction and Definitions

Introduction

Construction Management is the practice of professional management applied to the planning, design, and construction of projects from inception to completion for the purpose of controlling time, scope, cost, and quality.

As used in this document, Construction Management refers to the application of integrated systems and procedures by a team of professionals to achieve the owner's goals. These systems and procedures are intended to bring each team member's expertise to the project/program in an effective and meaningful manner. The desired result is to achieve a greater benefit from the team's combined expertise than could be realized from each individual's separate input.

Program and project organization molds the elements of the process to achieve the desired results. These elements are addressed in detail in this manual. It should be emphasized that if proper attitudes, goals, commitments, and philosophies are in place, along with an understanding of the expected standards of practice, the procedures required for successful, smoothly executed projects should follow.

The essence of good Construction Management is professionalism and teamwork. The CM, as a member of the team, should assume a position of leadership beginning with the establishment of a management plan. This should not be a position of dominance, but rather of service which integrates the individual elements of the project delivery process into a cohesive program.

This manual has been developed by addressing ten (10) distinct functions:

- Project Management
- Cost Management
- Time Management
- Quality Management
- Contract Administration
- Safety Management
- Program Management
- Sustainability
- Risk Management
- Building Information Modeling

These functions are not mutually exclusive, but are related and integral components of the Construction Management process. For ease of reference, each function is presented in the following phases:

- Pre-Design
- Design
- Procurement
- Construction
- Post Construction

These phases are consistent with the CMAA suggested scope of services and with established usage in the construction industry. The scope of services rendered by the CM encompasses a broad range of professional skills, management knowledge and experience. The fact that a CM is certified or licensed in any other profession does not necessarily establish them as a qualified CM. Individuals and firms practicing and rendering Construction Management services should be knowledgeable and experienced in the technical disciplines and management areas described in this manual. CMAA has developed an industry consensus concerning the qualifications and experience that identify a professional CM through its certification program.

Construction Management is a management approach that focuses on the delivery of professional services. There are several different forms and variations of the Construction Management practice. Each has its own definition, characteristics and menu of services. All variations can be placed in either the “agency” or “at risk” forms of Construction Management.

Under the CMAA A-1 Standard Agreement, the CM acts as the owner’s principal agent. The agency CM does not perform design or construction work. The services provided may depend on the in-house resources of the owner and the services being provided by the designer and other consultants. All contracts for design, construction, equipment, etc., are directly with the owner. The use of fast-tracking, phased construction or multiple-prime contracts is common, but not required.

When the CM’s role includes a construction performance function, it is known as “CM-at-Risk.” In this approach, which can often occur under a guaranteed maximum price (GMP) contract form, the CM will assume additional obligations and will undertake construction responsibilities during the construction phase. At that time, the CM is typically placed in a legal position similar to that of a general contractor entering into a traditional construction agreement that provides for the completion of the construction work for an established price.

Regardless of the form of contract agreement, the CM is performing professional tasks throughout all the phases of program/project implementation. A contract agreement will establish the scope of services and will also define the relationship of the parties. The term agency infers, as is intended, a delegation of function to the CM by the owner. As a consequence, it is possible that certain tasks and responsibilities place the CM in a legal agent relationship with the owner.

Definitions

The terms contained in these definitions are intended to convey a specific meaning as utilized in these standards. All other technical terminology herein may be presumed to follow accepted industry usage. To the extent possible, the defined terms are consistent with their use in the Standard Forms of Agreement and Contract Documents issued by CMAA.

Addendum

A supplement to documents, issued prior to taking receipt of bids, for the purpose of clarifying, correcting, or otherwise changing bid documents previously issued.

Additional Services

Services provided in addition to those specifically designated as basic services in the agreement between the owner and CM. Also known as supplemental services.

Agency

A legal relationship by which one party is empowered and obligated to act on behalf of another party.

Agency Construction Management

A form of Construction Management performed in a defined relationship between the CM and owner. The agency form of Construction Management establishes a specific role of the CM acting as the owner's principal agent in connection with the project/program.

Agreement

A document setting forth the relationships and obligations between two parties, as the CM and owner or Contractor and owner. It may incorporate other documents by reference.

Apparent Low Bidder

The bidder who has submitted the lowest bid for a division of work described in bid documents, a proposal form, or proposed contract.

Approved Bidders List

The list of contractors that have been prequalified for the purpose of submitting responsible, competitive bids.

Approved Changes

Changes in the contract documents that have been subjected to an agreed upon change approval process and have been approved by the party empowered to approve such changes. See "Change Order."

As-Built Drawings

Drawings (plans) that show the work, as actually installed. Also known as record drawings.

At-Risk Construction Management

A delivery method that entails a commitment by the Construction Manager to deliver the project within a Guaranteed Maximum Price (GMP). The Construction Manager acts as consultant to the owner in the development and design phases, but as the equivalent of a general contractor during the construction phase. When a construction manager is bound to a GMP, the most fundamental character of the relationship is changed. In addition to acting in the owner's interest, the Construction Manager also protects him/herself.

Basic Services

Scope of service as defined in the original agreement between the owner and CM as basic services.

Beneficial Occupancy

The use of the constructed facility by the owner prior to final completion of the construction.

Bid

An offer to perform the work described in contract documents at a specified cost.

Biddability

The degree to which a set of bid documents could be reasonably expected to permit a bidder to establish a competitive price to perform the work as defined in the bid documents.

Biddability Review

A formal review of the contract documents, addendum, and reference documents to be accomplished with respect to the local construction marketplace and the bid packaging strategy so as to eliminate ambiguities, errors, omissions, and contradictions, for the purpose of minimizing bid prices in the procurement phase and disputes during construction.

Bid Documents

The documents issued to the contractor(s) by the owner which describe the proposed work and contract terms. Bid documents typically include drawings, specifications, contract forms, general and supplementary general conditions, proposal or bid forms, and other information.

Bid Bond

A pledge from a surety to pay the bond amount to the owner in the event the bidder defaults on its commitment to enter into a contract to perform the work described in the bid documents for the bid price.

Bond

A pledge from a surety guaranteeing the performance of the obligation defined in the bond, including the completion of work or payment of the bond amount to the obligee (owner or contractor) in the event of a default, or non-payment by a principal (contractor or subcontractor), as with bid, performance and labor and material bonds.

Bonus

Additional compensation paid or to be paid to the contractor by the owner as a reward for accomplishing predetermined objectives that are over and above the basic requirements of the contract between the owner and contractor.

Budget

The dollar amount allocated by the owner for a project/program.

Budget Estimate

An estimate of the cost of work based on preliminary information, with a qualified degree of accuracy.

Changed Conditions

Conditions or circumstances, physical or otherwise, which differ from the conditions or circumstances on which the contract documents were based.

Change Order

A written agreement or directive between contracted parties which represents an addition, deletion, or revision to the contract documents, identifies the change in price and time and describes the nature (scope) of the work involved. Also known as a contract modification.

Claim

A formal demand for compensation, filed by a contractor or the owner with the other party, in accordance with provisions of the contract documents.

Code of Accounts

The owner's written description of the cost elements of the project, used for the owner's accounting purposes.

Commissioning

Start up, calibration, and certification of a facility.

CM Fee

A form of contractual payment for services, where the CM is paid a fee for services performed.

Contingency

An amount of money reserved by the owner to pay for unforeseen changes in the work or increases in cost.

Constructability

The ease with which a project can be built, based upon the clarity, consistency, and completeness of the contract documents for bidding, administration, and interpretation to achieve overall project objectives.

Constructability Reviews

The process of evaluating the construction documents for clarity, consistency, completeness, and ease of construction to facilitate the achievement of overall project objectives.

Construction Budget

The sum established, normally during the pre-design or design phase, as available for construction of the project.

Construction Cost

See "Cost of Construction."

Construction Management

A professional management practice applied to construction projects from project inception to completion for the purpose of controlling time, cost, scope and quality.

Construction Management Plan

The written document prepared by the CM, which clearly identifies the roles, responsibilities and authority of the project team and the procedures to be followed during construction.

Construction Manager (CM)

An organization or individual with the expertise and resources to provide Construction Management services.

Construction Schedule

A graphic, tabular or narrative representation or depiction of the time of construction of the project, showing activities and duration of activities in sequential order.

Contract Administration

The function of implementing the terms and conditions of a contract, based upon established systems, policies, and procedures.

Contractor

The organization or individual who undertakes responsibility for the performance of the work, in accordance with plans, specifications and contract documents, providing and controlling the labor, material and equipment to accomplish the work.

Construction Contract Documents

The documents which provide the basis for the contract entered into between parties. They typically include the bid documents updated to reflect the agreement between the owner and the contractor(s).

Cost Control

The function of limiting the cost of the construction project to the established budget based upon owner-approved procedures and authority.

Cost Management

The act of managing all or partial costs of a planning, design, and construction process to remain within the budget.

Cost of Construction

All costs attributed to the construction of the project, including the cost of contracts with the Contractor(s), construction support items, general condition items, all purchased labor, material and fixed equipment.

Critical Path Method (CPM)

A scheduling technique used to plan and control a project. CPM combines all relevant information into a single plan defining the sequence and duration of operations, and depicting the interrelationship of the work elements required to complete the project. The critical path is defined as the longest sequence of activities in a network which establishes the minimum length of time for accomplishment of the end event of the project. Arrow Diagramming Method (ADM) and Precedence Diagramming Method (PDM) are both common forms of CPM scheduling.

Critical Date Schedule

See "Milestone Schedule."

Design-Build

A project delivery method which combines architectural and engineering design services with construction performance under one contract agreement.

Designer

The individual or organization that performs the design and prepares plans and specifications for the work to be performed. The designer can be an architect, an engineer, or an organization which combines design services with other professional services.

Design – Schematic

Traditionally the first stage of the designer's basic services. In the schematic stage, the designer ascertains the requirements of the project and prepares schematic design studies consisting of drawings and other documents illustrating the scale and relationships of the project.

Design – Preliminary

The transition from the schematic stage to the completion of design development. During this stage ancillary space is developed and dimensions are finalized. Outline specifications are developed into technical specifications; sections are delineated and elevations are defined. Also known as design development.

Design – Final

The stage of the design process when drawings and specifications are completed for construction bid purposes. It is preceded by the preliminary design stage, and followed by the procurement phase. The designation used by designers for the last part of the design process prior to procurement.

Direct Costs

The field costs directly attributed to the construction of a project, including labor, material, equipment, subcontracts and their associated costs.

Drawings

Graphic representations showing the relationships, geometry and dimensions of the elements of the work.

Estimated Cost to Complete

The current estimate of the remaining costs to be incurred on a project at a specific point in time.

Estimated Final Cost

The anticipated cost of a project or project element when it is complete. The sum of the cost to date and the estimated cost to complete.

Fast Track

The process of dividing the design of a project into sub-phases in such a manner as to permit construction to start before the entire design phase is complete. The overlapping of the construction phase with the design phase.

Field Order

An order issued at the site by the owner or CM to clarify and/or require the contractor(s) to perform work not included in the contract documents. A field order normally represents a minor

change not involving a change in contract price or time and may or may not be the basis of a change order.

Final Completion

The date on which all the terms of the construction contract have been satisfied.

Float

Contingency time that exists on a scheduled activity. It represents the amount of time that activity may be delayed without effecting the end date of the schedule. It is measured by comparing the early start and late start, or early finish and late finish dates, of an activity.

Force Account

Directed work accomplished by the contractor outside of the contract agreement usually paid for on a time and material basis.

General Conditions

A section of general clauses in the contract specifications that establish how the project is to be administered. Included are obligations such as providing temporary work, insurance, field offices, etc.

Guarantee

A legally enforceable assurance by the contractor and/or a third party of satisfactory performance of products or workmanship during a specific period of time stated and included in the contract.

Guaranteed Maximum Price

A contractual form of agreement wherein a maximum price for the work is established based upon an agreed to scope.

Lien

A claim, encumbrance, or charge against or an interest in property to secure payment of a debt or performance of an obligation.

Life Cycle Cost

All costs incident to the planning, design, construction, operation, maintenance and demolition of a facility, or system, for a given life expectancy, all in terms of present value.

Liquidated Damages

An amount of money usually set on a per day basis, which the contractor agrees to pay the owner for delay in completing the work in accordance with the contract documents.

Long Lead Item

Material or equipment having an extended delivery time. Such items may be considered for early procurement and purchase under separate contract to facilitate on time completion of the project.

Long Lead Time

The extended time interval between purchase and delivery of long lead items.

Low Bidder

The responsible bidder who has submitted the lowest bid, which is determined to be responsive to the request for bids for a division of work described in a bid document, proposal form or contract.

Lump Sum Fee

A fixed amount that includes the cost of overhead and profit paid, in addition to all other direct and indirect costs of performing work.

Master Schedule

An executive level summary schedule identifying the major components of a project, their sequence and durations. The schedule can be in the form of a network, milestone schedule, or bar chart.

Milestone Schedule

A schedule representing important events along the path to project completion. All milestones may not be equally significant. The most significant are termed “major milestones” and usually represent the completion of a group of activities.

Multiple Prime Contracts

Separate Contractors contracting directly with the owner for specific and designated elements of the work.

Non-Conforming Work

Work that does not meet the requirements of the contract documents.

Notice of Award

A formal document informing an individual or organization of successfully securing a contract.

Notice to Proceed

A formal document and/or point in the project’s life cycle authorizing an individual or organization to commence work under its contract. The issuance of the notice to proceed typically marks the end of the Procurement Phase.

Owner Construction Management

A form of Construction Management that does not use an independent Construction Management organization as a team member. The owner performs all required Construction Management services with in-house staff.

Owner’s Representative

The individual representing the owner on the project team.

Penalty

A punitive measure, usually associated with failure to fulfill a contractual obligation.

Performance Bond

A pledge from a surety guaranteeing the performance of the work or payment of the bond amount to the obligee (owner or contractor) in the event of a default in performance of contractual obligations.

Phased Construction

An incremental approach to construction or design and construction. Each overlapping or sequential phase or element has a defined work scope and is considered as a separate project.

Plans

See “Drawings.”

Post Construction Phase

The period following substantial completion.

Pre-Design Phase

The period before schematic design commences during which the project is initiated and the program is developed; the planning and conceptual phase.

Prime Contract

A direct contract with an owner. It can be a single contract and/or include the work specified for several contracts depending upon division of work.

Prime Contractor

A contractor who has a contract with an owner.

Professional Services

Services provided by a professional or by an organization that has specific competence in a field of endeavor that requires professional (and technical) knowledge and capabilities and that meets recognized standards of performance.

Program Management

The practice of professional Construction Management applied to a capital improvement program of one or more projects from inception to completion. Comprehensive Construction Management services are used to integrate the different facets of the construction process—planning, design, procurement, construction and activation—for the purpose of providing standardized technical and management expertise on each project.

Progress Meeting

A meeting dedicated to the subject of progress during any phase of project delivery.

Progress Payment

Partial payment of the contract amount periodically paid by the owner, upon approval by the CM, verifying that portions of the work have been accomplished.

Project

The total effort required in all phases from conception through design and construction completion to accomplish the owner’s objectives.

Project Budget

The sum or target figure established to cover all the owner’s costs of the project. It includes the cost of construction and all other costs such as land, legal and consultant fees, interest, and other project-related costs.

Project Cost

The actual cost of the entire project.

Project Management

As applied to a construction project, the use of integrated systems and procedures by the project team to accomplish design and construction. Project management is an integral function of Construction Management.

Project Management Plan

A document prepared by the CM, and approved by the owner, which defines the owner's goals and expectations including scope, budget schedule, and quality and the strategies to be used to fulfill the requirements of the project.

Project Team Meeting

A meeting dedicated to all aspects of the project, involving the project team members [owner, designer, CM, contractor(s)].

Project Procedures Manual

A detailed definition of the project team responsibilities and authority, project systems, and procedures to be used for all phases of the project.

Project Team

Initially consists of the owner, designer, and CM. Thereafter, as prime contractors are engaged for construction they are added to the team.

Punch List

A list made near the completion of the construction work indicating items of work that remain unfinished, do not meet quality or quantity requirements as specified or are yet to be performed and which must be accomplished by the contractor prior to completing the terms of the contract.

Quality

The degree to which the project and its components meet the owner's expectations, objectives, standards, and intended purpose; determined by measuring conformity of the project to the plans, specifications, and applicable standards.

Quality Assurance (QA)

The application of planned and systematic methods to verify that quality control procedures are being effectively implemented.

Quality Control (QC)

The continuous review, certification, inspection, and testing of project components, including persons, systems, materials, documents, techniques, and workmanship to determine whether or not such components conform to the plans, specifications, applicable standards, and project requirements.

Quality Management

The process of planning, organization, implementation, monitoring and documenting of a system of

policies and procedures that coordinate and direct relevant project resources and activities in a manner that will achieve the desired quality.

Record Drawings

Drawings (plans), prepared after construction is complete, that represent the work accomplished under the contract.

Recovery Schedule

The schedule that depicts action(s) and special effort(s) required to recover lost time in the approved schedule. It can depict activities of any member of the project team.

Request for Change Proposal

A written document issued by the CM to the contractor that describes a proposed change to the contract documents for purposes of establishing cost and time impacts. May also be known as a bulletin or request for quote.

Schedule of Values

A list of basic contract segments, in both labor and material, where each line item consists of a description of a portion of work and a related cost and the sum of the line items equals the total contract price. Generally used to determine progress payments to the Contractor(s).

Scope

Identification of all requirements of a project or contract.

Scope Changes

Changes that expand or reduce the requirements of the project during design or construction.

Shop Drawings

Drawings typically prepared by the contractor, based upon the contract documents and provided in sufficient detail that indicate to the designer that the contractor intends to construct the referenced work in a manner that is consistent with the design intent and the contract documents.

Short Term Construction Activity Plan

The planning and scheduling of prime contractor(s) activities on site, for the short duration or “foreseeable future” usually developed on a week-by-week basis using milestones for planning intervals coordinated by the CM. Also known as a rolling schedule, “look ahead” schedule, or short interval schedule.

Special Conditions (of the Contract for Construction)

See “Supplementary General Conditions.”

Special Consultants

The designation for various professionals, including engineers, architects, designers and other experts, who provide expertise in specialized fields.

Specifications

The detailed written descriptions of materials, equipment, systems, and required workmanship and other qualitative information pertaining to the work.

Start-Up

The period prior to occupancy when systems are activated and checked out, and the owner's operating and maintenance staff assumes the control and operation of the systems.

Subcontractor

A contractor who has a contract with a prime contractor to perform work.

Substantial Completion

The date, certified by the designer or CM or both, that the contractor has reached that stage of completion when the facility may be used for its intended purposes, even though all work is not completed.

Submittals

Transmittals of information as required by the contract documents.

Supplementary General Conditions

Additions and/or modifications to the general conditions, which are part of the bid documents and/or contract documents.

Testing

The application of specific procedures to determine if work has been completed in the prescribed manner and at the required levels of workmanship. See "Non-Conforming Work."

Trade Contractors

Construction contractors who specialize in providing and/or installing specific elements of the overall construction requirements of a complete project.

Trade-Off Study

The study to define the comparative values and risks of a substitution or exchange of a design component. The trade-off can identify both monetary and functional values. Also known as an alternatives analysis.

Value Analysis

See "Value Engineering."

Value Engineering

A specialized cost control technique, which utilizes a systematic and creative analysis of the functions of a project or operation to determine how best to achieve the necessary function, performance, and reliability at the minimum life cycle cost.

Warranty

Assurance by a party that it will assume stipulated responsibility for its own work.

Work

The construction, to include all labor, material and equipment, required by the contract documents.

Chapter 2: Project Management

Introduction

This section discusses the broad subject of project management, which is defined by CMAA as "The use of integrated systems and procedures by a team of professionals during project design and construction." The section focuses on the key components of a Project Management Plan and its development throughout the various project phases. In general terms it outlines key goals and elements of managing a project under the Construction Management format. The general approach addressed here is expanded upon in subsequent Standards of Practice sections on Cost, Time and Quality Management, Contract Administration, Risk Management, Sustainability and Safety.

Pre-Design Phase

Project Organization

During this phase of the project the owner must assemble and organize a project team composed of design and Construction Management professionals as well as other key professional, technical and administrative staff necessary to assure the success of the project. This project team must organize its activities to deliver a project that meets the owner's requirements.

The project team should include representatives of the owner, the Construction Manager (CM), the design professional, and any specialty professionals that may be required. In some delivery systems, the general contractor is part of the pre-design team. Basic project purposes, goals and parameters of performance – particularly cost, time, and quality – should be determined and documented by the owner and provided to the project team at the earliest opportunity.

The CM and the design professionals should be hired as early as possible. In situations where the CM is hired first, the CM should assist the owner in developing a list of qualified design firms. Additionally, the CM should assist the owner in developing and transmitting the requests for proposals, reviewing the proposals, conducting interviews, evaluating candidates and making recommendations for the award of the design contract. When the design professional is hired first, he may assist the owner in a similar manner in the selection of a CM.

The organization of the project should be guided by the following principles:

- The owner, design professional and CM must establish a relationship of mutual trust and respect. The design professional and CM, while clearly having different roles and responsibilities, should function as equals and be so treated by the owner in order to gain the full benefit of the team's collective effort.

- It is recommended that the procedures outlined in the CMAA document "How to Select a CM" be used in the CM selection process.
- Each team member must know and understand the other members' responsibilities, in addition to the overall project requirements, prior to signing individual contracts. The best way to accomplish this is by all parties performing a joint review of their respective contracts. The owner, CM, and design professional should then create a responsibility matrix which documents all tasks, action items and authority of all team members.

Project Management Plan

The CM should work with the owner and the design professional to define the project requirements in the Project Management Plan (PMP). This document, prepared by the CM, should outline the strategies for fulfilling the requirements of the project. The owner should review and approve the PMP before the project proceeds. This document may then be used to measure the performance of the project team and the overall success of the project. Therefore, it is critical that it be understood at the outset by all team members.

The PMP typically establishes the scope, budget, schedule, environmental conditions, and the basic systems to be utilized. It also defines the methods and procedures to be followed as well as the basis for claims avoidance on the project. Many conceptual design and estimating iterations may be required before a project meets the owner's time, cost and performance requirements. Once these requirements are established and approved by the owner, the team must be committed to completing the project within those requirements. The PMP and the commitment of all stakeholders to meet its requirements form the foundation for a successful project.

Typically, the scope of a project is documented by a combination of conceptual drawings, descriptive narratives, performance parameters, and the budget for the project. The type of information and amount of detail may vary considerably based upon the type of project. Documentation of overall cost and time is the CM's responsibility, with input from the other team members. The establishment of basic systems and procedures by the CM links the task elements of the Plan.

A typical PMP may include the following basic components. Some of the components may be developed in later phases of the project as part of the Construction Management Plan:

- Project description
- Scope of work
- Milestone schedule
- Master schedule
- Quality management approach
- Safety management plan
- Reference to project documents
- Project organization chart and staffing plan
- Explanation of roles, responsibilities and authority of team members
- Project budget/work breakdown structure
- Certification under the LEED® program (Leadership in Energy and Environmental Design)
- Logistics including temporary construction support requirements, i.e. laydown or marshalling area

- Environmental/archeological considerations
- Reference to project procedures manual
- Management information system
- Communications protocol
- Bid packaging and contracting strategy, and delivery system evaluation
- Site mobilization and utilization phase

Project Procedures Manual

The Project Procedures Manual should be developed as a team effort, assembled and edited by the CM. It should be written so that the responsibilities of the team, levels of authority, communication protocol and the systems, methods and procedures to be followed for project execution are clearly defined and understood.

The Manual should address:

- Cost controls and the systems required for monitoring and controlling project costs
- Quality control and quality assurance program established by the Team and how it is to be implemented
- The project schedule and how it is to be developed, implemented and maintained
- Document control and specific project systems, methods and procedures (i.e., bidding, payments, change orders, submittals, correspondence, reports, performance records, claim resolutions, etc.)
- Functional responsibilities and limits of authority
- Correspondence distribution matrix
- Safety program
- Check lists
- Listing of meetings (i.e. type, frequency)
- Sample forms to be used
- Detailed bidding and construction phase procedures
- Coordination among various prime contractors
- LEED requirements

Pre-Design Project Conference

The CM should plan, conduct and document a pre-design project conference which addresses the Project Management Plan with respect to the design phase. The conference purpose is to achieve commitment to the project goals and procedures from the owner, the design professional, and the CM.

Management Information System

The CM should establish a management information system that will inform the team about the overall project status and forecast compared to the Project Management Plan. This system should address team information needs, data sources and control elements for time and cost. The system should provide a sound basis for managing the project and identifying and evaluating problem areas and variances. Distribution, frequency of reports, and the policy for record retention should also be established.

A comprehensive account of the project can be achieved with record keeping systems such as:

- General correspondence files (in and out)
- Periodic reports (daily, weekly, monthly)
- Drawing schedules, submittals (shop drawings, payments, samples)
- Transmittals
- Change requests and authorizations
- Procurement
- Material control
- Meeting minutes
- Confirmation of oral instructions and field directives
- Controlled inspections
- Notice of non-conforming contract work
- Weather conditions
- Scheduling records
- Progress photographs

The financial status reports must enable both the owner and the CM to control the available funds in the project. The format of reports should accommodate a continuing input of data. This data should serve as a budgeting and cost control tool on a contract phase and total project basis.

Financial reporting should cover budgeted, authorized and committed funds, expenditures to date, cost to complete, invoices, payments and retention, change orders, projected total costs and projected cash flow.

The CM should coordinate with the owner's and the design professional's staff to determine the format and frequency of reports required by the team members. Information should include schedule and progress reporting, drawing schedules, budget versus cost of services, and change requests (approved and pending) for design services. The first reports should be issued during the pre-design phase and on an agreed frequency thereafter.

Design Phase

During the design phase the team must continually communicate and consult on all substantive issues. As the process proceeds from schematic through final design, the team must consider the issues critical to each particular phase, moving from general decisions in the early phase to detailed decisions as design progresses. There should be periodic constructability reviews by the CM. The owner and the CM should agree on the scope and number of constructability reviews required. The CM should also coordinate with any needed Value Engineering and alternative studies. The goal is to complete a set of documents defining a project which can be bid in the current local marketplace within the owner's budget and time requirements.

The design professional has total responsibility for design implementation and execution. The role of the CM during this phase should be to assist the team by carrying out the activities listed below. Although the designer is responsible for design decisions to meet the project requirements, the owner as well as CM and other stakeholders can also have decision making responsibility.

Design Document Review

The CM should review the design documents periodically, focusing on the need for clarity, constructability, consistency and coordination among the trades and contractors as appropriate.

Document Distribution

The CM should coordinate the distribution of information among all team members and the transmittal of all documents to regulatory agencies.

Contract Agreements

The CM should develop and/or review appropriate construction contract agreements for inclusion in the bid documents.

General and Supplementary General Conditions

The CM should develop or review general and special conditions consistent with project requirements.

Public Relations

The CM should assist the owner in public relations activities, particularly those with respect to the owner's organization and community relations. The CM should assist the owner in developing interest among bidders for the project(s) also.

Project Funding

The CM should assist the owner in preparation of documents necessary to secure funding for the overall project.

Meetings

The CM should conduct periodic project meetings to assess progress, verify adherence to the PMP, document performance, plan for completion, and take action to resolve current problems. At a minimum, these meetings should be held at the end of each design phase. A final team review should be conducted prior to release of each bid package. Recommended subjects for each project meeting include:

- Review of the project budget and a current estimate of what construction costs the drawings and specifications currently represent, making allowances and assumptions for detail not shown or known
- Review of the Master Schedule, Milestone Schedule and any additional detailed sub schedules for the project
- Discussion and resolution of any issues which have become evident through previous review of documents and/or team discussion and have not been addressed

Cost Control

During the design process the CM develops and maintains cost control procedures to monitor and control project expenditures, both current and projected, within the allocated budget.

Schedule Control

During the design process the CM develops, implements, and modifies the master schedule and the milestone schedule, periodically updating them to reflect actual performance to date. The CM also

establishes forecast dates for the completion of the project and advises the owner and designer relative to performance against that baseline.

LEED Compliance

Either the CM or the LEED Professional shall provide guidance and oversight during design to assure the established LEED goals are being addressed. The CM should have a LEED accredited professional on staff.

Ongoing Consulting Activities

The CM makes recommendations to team members regarding constructability, cost, phasing and sequencing of construction, construction duration, impact of alternative construction methods and separation of contract categories.

At the end of the design phase, designated representatives of each team member review all design documents and concur that they are complete, coordinated, adequately representative of the owner's needs, and suitable for construction.

Procurement Phase

The goal in this phase is to secure bidders for each bid package who are qualified, competitive, interested in the work, and capable of doing the work within the project time requirements.

Bidding and Contracting Process

The bidding and contracting process is a key element in the success of the project. The CM is responsible for performing or assisting the owner with the following procurement phase activities:

- Solicitation and pre-qualification of bidders and guidelines by which bidders will be evaluated
- Notices and advertisements
- Bidders' interest campaign
- Delivery of bid documents
- Information to bidders
- Issuance of addenda
- Bid opening and evaluation
- Monitoring compliance with and execution of construction contracts
- Arrangement for owner purchased equipment and materials
- Provision for permits, insurance and labor affidavits

Meetings

The following meetings may be part of the bid and award process:

- Pre-bid meetings
- Bid openings
- Pre-award conferences

Each of the above tasks and meetings are described in more detail in Chapter 6: Contract Administration.

Construction Phase

The goal in this phase is to expedite and improve the efficiency of the construction process through professional planning and execution of project activities, all focused upon fulfilling the owner's scope, cost, quality, and time requirements.

Prior to construction, the CM should develop a project specific Construction Management Plan that clearly identifies the roles, responsibilities and authority of the project team and the procedures to be followed during construction.

Below is an outline of key construction phase activities. A detailed identification of separate elements is presented in Chapter 6: Contract Administration.

On-Site Facilities

The CM should verify that office facilities and site work required for general access and utilities to all on-site organizations are provided. The cost of the work may be paid directly by the owner or by the CM as a reimbursable cost. Alternatively, some or all of the work may be included in individual construction contracts.

Coordination

The CM provides coordination and leadership of the individual professionals and contractor(s) in meeting the project requirements. To help accomplish this, all communications with professionals and contractor(s) are either through the CM or with his prior knowledge. There is no circumventing of formally established lines of communication by the owner, design professional or individual contractor(s).

Meetings

There are three (3) basic categories of meetings involved in the construction phases: pre-construction, progress, and special meetings.

The purpose of pre-construction meetings is to orient all on-site contractors to project procedures and site utilization requirements and to review near term and long term activity plans. The CM will discuss a comprehensive list of contract communication, administrative and coordination requirements including the lines of communication, shop drawing procedures, and general written communication protocol.

Progress meetings are designed to monitor compliance with schedules and the requirements of the contract documents to coordinate the contractor(s) efforts and to allow short- and mid-term planning and problem solving. The CM organizes, conducts, and records regularly scheduled progress meetings involving the CM, contractor's principal personnel, the design professional, and the owner, as required. Meetings may be conducted weekly, bi-weekly or at least once a month.

Special meetings are called, as necessary, to resolve issues of an immediate or short term planning nature that cannot wait until the regularly scheduled progress meetings, or to discuss issues requiring detailed discussions not suitable for the progress meeting. Although the CM has primary responsibility for determining the need for these meetings, the owner, design professional or contractor may call a special meeting through the CM.

Time Management

The CM establishes procedures for planning and monitoring compliance with the project time line, which relates to the master and detailed construction schedules. This procedure involves the owner and design professional at appropriate time intervals.

It is important that this process also involve the on-site contractors in the development and updating of project schedules. The CM should generate cooperation and obtain commitment from each contractor to complete the project within the owner's time requirements and as required by the contract documents.

The CM should also look for opportunities to recover schedule slippages as appropriate. The time management process also forms the basis for evaluating and resolving time related contract claims.

Budget and Cost Monitoring

For the benefit of the owner, the CM maintains responsibility for tracking, projecting, and monitoring costs through the construction phase. As contracts are awarded, the individual line item estimates are replaced with actual committed amounts, plus cost estimates for any unknowns or contingencies. The goal is to manage the incurred costs, estimated costs and costs to complete in order to stay within the budget.

Payment Requests

The CM should implement procedures for processing contractor's payments in conformance with contract requirements. Monthly meetings should be scheduled to review and discuss the pay request.

Change Orders

The specific, documented procedures for initiating and approving contractor change orders are implemented by the project team. The CM should take the lead in administering this procedure.

Claims Management

The CM establishes methods and procedures to minimize the impact of claims through prompt and equitable resolution with minimal disruption to the ongoing construction effort. Procedures should address receiving and disposition of claims submitted, merit evaluation, entitlement evaluation, negotiation and settlement procedures, handling of disputes, and appeal procedures. All claims and potential claims should be discussed weekly at the progress meetings.

Quality Management

The CM monitors contractor compliance with the quality level expected for the project. The CM develops procedures for monitoring the quality of work being performed. The CM's responsibilities for quality control or quality assurance should be clearly spelled out in the CM's contract.

In most cases the construction contractor is responsible for the quality control function and compliance with the quality required by the contract documents.

The CM arranges for and coordinates field testing which is not a part of individual contractor's work scope.

Acceptance and Performance Testing

If so required by the contract, the CM will monitor the acceptance and performance testing to see that it is conducted in accordance with contract requirements. The contractor will need to provide opportunity for observation of these tests by the CM as well as filing all appropriate test reports.

Final Inspection and Punch Lists

After receiving written requests from the contractor, the inspection staff will consider whether the contract work is substantially complete and will conduct a final inspection with the contractor, project staff and owner's representatives. During the final inspection, the CM develops the project punch list of remaining contract work. If the remaining items are not critical to occupancy or use, the contract will be declared substantially complete. The CM must monitor the completion of the remaining punch list items which should be completed by the time frame specified in the bid documents. Upon completion of the punch list, the CM will issue a final inspection report.

Owner Occupancy (Partial Acceptance/Beneficial Occupancy)

Upon declaring the contract substantially complete, the CM will assist the owner in taking beneficial occupancy of the project. This may include filing of the appropriate reports and approvals before governing boards or other owner representatives. In certain circumstances, partial acceptance can be taken for project elements that are substantially complete.

Owner Purchased Materials and Equipment

Prior to construction, the CM should identify long lead materials and equipment for pre-purchasing, and other materials and equipment, which could be direct purchased to the owner's advantage. During construction, the CM coordinates scheduling, on-site delivery and storage, and installation and start-up requirements for these materials and equipment.

Record Drawings

Record drawings should be provided by the contractor(s) doing the work and, minimally, be in the form of a dedicated set of contract drawings and specifications marked up as the work is installed. The CM should monitor the record drawing process monthly during construction in conjunction with review of contractor application for payment, and should receive these drawings at the completion of construction for transmittal to the owner, together with a set of specifications.

Record Keeping

A smooth, efficient and expeditious flow of paperwork is critical to project operations. The CM should establish systems for flow of all project related paperwork.

Management Reporting

The CM has a responsibility for establishing a management reporting system to keep the various team members informed on project status.

The CM should determine the type, format, frequency and distribution of information and reports required in accordance with the Construction Management Plan and the Project Procedures Manual.

LEED Management

The CM shall establish a tracking system to monitor compliance with the established LEED goals for the project. Closely associated with acceptance and performance testing is commissioning for the purposes of LEED certification. The CM should be familiar with these requirements and is referred

to in the United States Green Building Council publications for reference. The CM, in coordination with the project designer, oversees the commissioning process when an independent commissioning agent is retained. Otherwise, the CM will be responsible for the commissioning process. While commissioning is underway, the CM must complete and submit all LEED documentation for certification of points obtainable during the construction process and in accordance with contract documents. It is strongly recommended that, for a LEED project, the CM have a LEED Accredited Professional on staff as an integral part of the project management team.

Post-Construction Phase

Expeditious and effective project close-out is a critical element of a successful project. The CM's responsibility in this phase typically consists of the following:

- Obtaining LEED certification
- Completion of punch list items not required for substantial completion
- Facilitating owner occupancy
- Assembling record drawings for as-built documentation
- Warranty, guaranty, and operation and maintenance manuals
- Pursuing resolution of warranty items
- Documentation of final pay quantities and costs
- Preparing contract files for transfer to owner
- Final payment and contract acceptance

Assembling Record Drawings for As-Built Documentation

As indicated in the previous section, record drawings are maintained by the contractor and should be inspected monthly during the construction process to ensure the timely submittal of complete documentation to the owner at project completion. These record drawings are then submitted to the owner or design team for generation of the as-built documentation. The CM must ensure that accurate and timely as-built drawings and specifications are provided to the owner as soon after completion of construction as possible.

Warranty, Guaranty, and Operation and Maintenance Manuals

Prior to project close-out, the CM must gather all warranty, guaranty and O&M manuals, ensure that all comply with contract requirements and submit these to the owner. If specialized training is required, the CM oversees training by the contractor, which usually must occur before formal acceptance of the project.

Warranty Administration

If requested by the owner, the CM should manage the resolution of all issues identified as warranty issues, including evaluating whether the issue is in fact a warranty issue, notification of the prime contractor and appropriate sales and suppliers, and verification that warranty work is satisfactorily completed.

Documentation of Final Pay Quantities and Costs

The CM must compile documentation to support final quantities and final payment of unit price items and change order work. Documentation must be sufficient for audit purposes.

Preparing Contract Files for Transfer to Owner

The CM must prepare the contract files in accordance with the owner's requirements to facilitate their transfer to the owner for archiving.

Final Payment and Contract Acceptance

The CM should support the owner to accept the contract as complete and process the final payment.

Final Payment and Closing the Contract

The CM assembles all documents relating to final payment, including retention, unresolved change orders and unpaid invoices, for approval by the owner. Once approval is received for the final payment, which resolves all outstanding financial obligations with the contractor, the payment is processed and the contract closed. If there are any claims or adjustments requested by the contractor, the contract cannot be closed until these are completely resolved.

For further information:

*CMAA's Cost
Management Guidelines;
CMAA's Time
Management Guidelines;
CMAA's Contract
Administration
Guidelines*

Chapter 3: Cost Management

Introduction

This section presents guidelines for the CM to assist the team members in managing, controlling, and monitoring project costs during all phases of a project through an integrated and comprehensive cost management system.

Effective cost management involves the establishment of a realistic project budget, within the owner's cost limitations, and the application of cost management skills and techniques to ensure the project is planned, designed, procured, and constructed in the most economical way, respecting the original project requirements and supporting the project's life cycle cost plan.

The cost management system should be aligned with the project work breakdown structure and compatible, where practical, with the owner's code of accounts. It should reflect the owner's and CM's need to obtain cost data in a usable format and timely manner.

Preliminary Cost Investigation

A cost management plan, including all cost components, is assembled by the CM for review and approval by the owner and the design professional. Each party approves the cost plan, which then becomes the basis and framework within which the costs of the project are controlled through the entire design and construction process.

Pre-Design Phase

Prior to developing any construction cost data, the CM becomes familiar with the site of the proposed project and thoroughly investigates factors likely to affect construction operations and project costs.

In addition, the CM assesses the construction economy and investigates the potential project risks. The CM conducts a local market survey to determine current costs, availability of labor, materials, and equipment, current and future bidding climates, local code requirements, and other related factors. An initial analysis of risk issues that may potentially threaten the project along with opportunities that may exist should also be conducted by the CM.

An important tool for the CM is a construction cost database for similar projects which serves to provide the basis for parametric cost modeling. This should be compiled by or obtained from a reputable source. A database of historical cost information coupled with site specific knowledge and

an understanding of local construction economics enables the CM to begin to forecast construction costs of the project.

Project and Construction Budget(s)

Based on the owner's project goals in terms of performance, quality, and time constraints, the CM develops an estimate of the cost of construction. If possible the CM should also compile an estimate of total project cost, specifying the basis of each estimate. This information is incorporated into the Project Management Plan.

Since the level of definition at the budget estimate stage is typically general, a design contingency as high as 15 to 25 percent should be considered (depending on data available) and added to the total of the estimated construction costs. The CM makes the owner aware that the ultimate cost of the proposed project depends upon the quantity and quality of systems yet to be defined and the current estimated construction cost is based on data available at this stage of the project.

The estimates of construction and project costs are developed into project and construction budgets in formats based upon work breakdown structures that are consistent with project components and acceptable to the project team.

The CM reviews the budget for comprehensiveness, compatibility with any established cost limitations, and attainability; the CM reviews the findings with the owner and the design professional in order to make necessary design, program, schedule, and/or budget adjustments to conform to owner requirements.

It is of critical importance that a basis-of-estimate document be prepared to accompany the budget. Any assumptions, clarifications, and exclusions made in the preparation of the project and construction budgets should be clearly identified. This is also a good point to start documenting risks and opportunities inherent in the project.

Cost Analysis

At the pre-design phase of a project, the owner may request the design professional to develop conceptual design alternatives based on different site locations and/or project schemes. The CM prepares cost estimates for these alternatives for review by the owner and the design professional. Preferably any alternatives that will be included in bidding documents should be structured as add alternatives as opposed to deduct alternatives; this typically enables better procurement value for the project.

When different sites are being considered, it is important to recognize fully the cost differentials for utilities, soil conditions, topography, access, location, market conditions, labor, etc. The owner at this stage may also request other studies, including life cycle cost studies, energy studies, and preliminary cash flows. All such studies should be presented in reports issued by the CM and reviewed with the owner and the design professional.

Design Phase

The approach to managing costs during the design process should be proactive not reactive. The active participation and coordination of the CM with the design team in providing timely cost advice can significantly reduce the need for redesign because of cost overruns.

Estimates

Following the approval of the construction budget, the CM provides ongoing cost management services to ensure that the budget is adhered to as the design is developed by the design professional.

A uniform cost estimating framework is established and maintained from inception through the pre-design, design, bid and award, and construction phases of the project. The application of a uniform framework facilitates consistent cost reporting and the ready identification of cost changes as the design develops.

Generally, estimates should be prepared by the CM to the level of detail available on the drawings and specifications, supplemented by notes and verbal data provided by the owner and/or the design professional. All verbal data should be confirmed in writing and noted in the estimate.

At the conceptual, schematic, and design development stages, cost data on a parameter basis by element and project type is usually appropriate. Since these data are usually historical, they should be adjusted or normalized for time, location, scale, and other factors influencing costs.

At preliminary design and final design document phases, a deterministic estimate with cost data at a unit price level is many times more appropriate. This involves quantity takeoff and unit pricing of the individual components of the trade or element (i.e., concrete, reinforcing steel, forms, etc.). These data should be reviewed, verified and adjusted as necessary before use.

Unit prices are often presented as composite rates inclusive of labor, materials, and equipment. However, many projects also require quantities to be presented with labor, material and equipment pricing separated. CM's utilize modern spreadsheet programs and estimating databases to facilitate the organization, sorting, and presentation of cost estimates.

When developing estimates of construction cost during the design phase, the CM refers to all available documents including the design specifications. Specifications need to be carefully studied since they can provide critical supplemental information which may not be depicted on the drawings and may have significant cost implications.

Unit costs should reflect current market pricing, with escalation addressed as a separate and distinct line item. Estimates of escalation in construction costs should be computed based on a monthly rate from the date of the estimate to the midpoint of construction. As the project moves into construction document phase, the escalation may be refined by escalating major components of the project in accordance with the procurement schedule. There are a variety of industry sources that provide cost escalation rates and forecasting data. It is important that escalation data be carefully reviewed especially on large or long term projects.

Cost Verification Stages

To verify that the project remains within the construction and project budgets, it is recommended that (as a minimum) estimates be prepared by the CM at the following stages of the design process:

- Completion of schematic design
- Completion of preliminary design

- In-progress final design (may vary from 60% to 90% complete)
- Completion of bid documents (including any issued addenda)

Each project must be evaluated based on its unique conditions and the above-named characteristics. Design contingencies should be set for each of the cost verification stages.

The design contingency level reflects the levels of accuracy it is reasonable to expect from estimates at various stages of the project's development. The project team determines the percentage allowable for design and construction contingencies on an individual project basis.

Schematic Design Estimate

The CM prepares a schematic design cost estimate based on measurement of parameter quantities from the design professional's schematic design stage submittal. It may also be possible to measure approximate quantities for certain elements of the project.

Preliminary Design Estimate

The CM prepares a preliminary design cost estimate based on measurement of approximate or parameter quantities from the design professional's preliminary design submittal. As the mechanical/electrical designs typically lag behind the architectural/structural designs, preliminary design estimates often contain approximate quantities for the architectural/structural/civil works and parameter quantities for the mechanical/electrical components.

In-Progress and Final Design Document Estimates

Cost estimates prepared from working drawings and specifications are based on quantity estimates for all major components. Any alternatives to be called for in the bid documents should be quantified and estimated.

Value Analysis/Value Engineering Studies

Value analysis or value engineering studies are used for the purpose of optimizing value in project designs.

During the design, the CM provides value analysis studies taking into account capital, operating, and maintenance costs to verify that the most cost effective design solution has been achieved. If the studies are conducted before the design data are developed, the reports could be too conceptual to be of value. However, if the studies are delayed, redesign may be necessary to reflect the recommendations of the study. Therefore, these studies are best completed during the initial preliminary design stage. If necessary, the CM should bring in independent expertise such as Certified Value Specialist (CVS) for these analyses.

Cost Monitoring and Reporting

The CM provides ongoing cost monitoring as may be necessary to assist the design professional in maintaining compliance with the construction budget.

In addition to cost reporting provided by the submission of estimates, the CM provides other cost reporting as may be required by the owner. It is recommended that all cost monitoring performed by the CM between the various estimate submittal stages be recorded and forwarded to the owner as part of the cost management system outlined in the Project Procedures Manual

The CM constantly monitors the design to identify changes in scope, evaluate the time and cost impacts of those changes, and report the impacts to the Project Team.

The number of estimates to be submitted and the extent of ongoing cost management services, value analysis, trade-off studies, and other similar activities should be determined with the owner at the time the Construction Management services are negotiated.

Procurement Phase

Estimates for Addenda

The CM should price in detail all proposed addenda. The quantification and pricing methodology should be the same as that used in the final estimate of construction cost submitted to the owner for approval at the end of the design phase.

Bid Analysis and Negotiation

The CM should tabulate all bids received and prepare a bid analysis, including the evaluation of all alternate bids and unit prices, compared with the final estimate of construction cost based on the bid documents. The bid tabulation method should be consistent with previously prepared cost estimates.

The CM's cost management role during this stage is to tabulate bids and establish that they are fully responsive to the requirements of the construction documents and meet the expectations of the construction budget.

Construction Phase

The CM should monitor cost management procedures through the completion of construction.

Schedule of Values

A schedule of values should be created shortly after contract award and must be reviewed and mutually agreed upon by the parties to avoid under- or over-payments during the project. The apportionment of indirect costs to the pay items must be carefully accomplished to ensure equitable reimbursement and to avoid inequities such as "front end loading."

The schedule of values should be detailed enough to allow accurate evaluation and calculation of amount to be billed. Once established, the schedule of values will reduce the occurrence of payment application disputes. There are two major methods used in reviewing progress payments:

- When the percentage of completion of scheduled activities method is used in determining the contractor progress payments, the CM should, in conjunction with the contractor(s), determine a schedule of values for each of the scheduled activities.
- When the percentage of completion by division of work is used in determining the contractor progress payments, the CM should, in conjunction with the contractor(s), determine a schedule of value for each bid package. This information should be used as the basis for all future progress payments to the contractor.

Change Order Control

As part of the overall financial control during the construction process, the CM establishes and implements a change order control system.

Once it is agreed that there has been a revision to the contracted scope of work there should be an adjustment to the contract price or time, or both. Determining a fair and equitable adjustment amount is a matter of obtaining and reviewing the supporting data as proof of costs. Organization of the data and a thorough understanding of the scope of the change order are integral in the review process.

The CM prepares an estimate of the cost of the change order listing the anticipated labor, material, equipment, subcontract work, contractor's overhead and profit, as well as any justified impact costs. Special attention should be given to reductions in the scope of work because these can easily be overlooked. The effect of the change on the schedule should be analyzed for time impact. This work should be completed in advance of receiving the change order pricing from the contractor so that an evaluation of the price can be made without delay.

Two types of pricing of change orders may be involved:

- **Forward pricing** - the pricing is done prior to the start of or during the work. The estimate of costs should itemize production rates, crew compositions, hours and equipment. Material costs should be listed and substantiated with quotes and price lists.
- **Post pricing** - the pricing is done at some point during or after the work is completed and represents actual costs based on records of man-hours consumed and material and equipment used. Comprehensive cost records are imperative. On force account work, the Work should be documented and verified daily by both the CM and the contractor.

In forward pricing the CM should also consider these special factors when evaluating production rates:

- Status and condition of the work
- Relative size and capability of the contractor(s)
- Size and complexity of the change
- Climatic conditions
- Mechanization that is possible
- Labor agreements
- Trade practices
- Learning curve
- Additional supervision required by the change

When evaluating material and equipment costs, the CM should also consider these special factors:

- Salvage of job material
- Odd lot sizes that add to cost
- Special delivery cost
- Potential higher price for proprietary items
- Escalation of costs since the original job was bid
- Storage costs that may be necessary
- Premiums for payment and performance bonds
- The necessity for additional insurance coverage
- Additional inspection and testing costs that may have to be added to the contractor's pricing to arrive at a total cost of the change

- Special equipment that may be required to perform the work

While impact costs, if any, may be difficult to quantify, the following issues should be addressed:

- Changes in sequence of work
- Changes in method and manner planned for doing the work
- Discontinuity of work
- Premium time incurred to overcome delays
- Congestion of work area
- Added mobilization and demobilization
- Effect on all contractors

Large impact costs, if any, can sometimes be determined by:

- Actual cost of identical work performed or what is sometimes referred to as a “measured mile” approach
- A reasonable estimate of the work cost if a change had not been encountered compared to the estimated cost of change order job conditions, or compared to the actual cost of work performed if post pricing was used
- Audit of the contractor's job cost records

Overhead and profit allowed on change order work should be established as fixed percentages by the original contract.

Trade-Off Studies

During the construction phase, the CM performs component studies on materials, systems, equipment, and accessories to ensure that economical and competitive components are selected consistent with the construction budget. Trade-off studies should be fully documented with the CM's recommendations and submitted to the owner and design professional.

Claims for Cost

The CM establishes a detailed audit record trail so that, in the event of subsequent audits, claims or investigation, a complete and comprehensive record of all project-related financial transactions is available in order of activity. (*See Chapter 4: Time Management | Construction Phase*)

Post Construction Phase

Final Cost Report

The CM summarizes total project costs in a final report, listing all change orders and identifying any unresolved issues which may have a cost impact. This report should be reviewed and provided to the owner.

Chapter 4: Time Management

Introduction

Construction Management involves the management of three basic project parameters: cost, time, and scope (including both the quantity and quality of the work). All Construction Managers (CM) recognize that these three parameters are closely linked and that a change in one can affect the others. In the parlance of the Construction Management profession, this linkage is sometimes known as "triple constraint" theory and is often represented by a triangle with pinned corners. Increase or decrease the length or magnitude of one side of the triangle and the lengths of the other sides are affected. So if the scope is increased, then the sides of the triangle representing cost and time may be increased, as well.

Theoretically, then, Construction Management involves managing these three parameters and maintaining the proper balance between competing objectives. Time management is an integral part of the CM's responsibilities on a project. This responsibility is met when the CM makes the most effective use of people, equipment, materials, and funds relative to time.

The CM achieves the most effective use of project resources through careful planning and expert execution. The primary time management tool used by CMs to meet these goals is the schedule. Consequently, the standards of Construction Management practice relative to time management are defined in this section in terms of the preparation, use, and analysis of schedules. How the CM achieves these goals depends on project type, size, and complexity, and the constraints of time, cost, and scope. In addition, the CM's responsibilities and, hence, the standard against which a CM's performance will be measured, must always consider the CM's role on the project, the applicable contract documents, and the other constraints under which the CM is working.

Generally, the CM's responsibilities related to time management can be summarized as follows:

- The CM ensures that the project team develops a project plan that considers time.
- The CM ensures that the project team develops a schedule to both plan and monitor time on the project.
- The CM guides the project team as to the appropriate form and content of the project schedule.
- The CM acts as the leader of the time management and scheduling effort.

This last responsibility itself has several basic pieces. Depending on the contractual relationships established among the parties on the project, the CM may be responsible for all or some portion of the following tasks:

- Developing the project schedule. This may include everything from collecting the necessary data related to work activities, durations, resources, and logic, to assembling these pieces into a coherent plan for time on the project.
- Updating the project schedule periodically to allow the project team to track, measure, and monitor its progress against its original plan.
- Revising the project schedule to reflect changes in the scope of the work or the plan for execution.
- Monitoring and analyzing the schedule to track project performance relative to time and alert other parties to deviations from the established plan.
- Should the project fall behind schedule, recommending mitigation actions to be taken by the project team to bring the project back within established goals or recommending revisions to project goals.
- Advising the project team regarding appropriate contract provisions relative to scheduling and time extensions.
- Reviewing, recommending acceptance of, and monitoring the schedules, schedule updates, and revised schedules prepared and submitted by other project participants.
- Preparing schedule analyses or reviewing, evaluating, negotiating, and making recommendations related to time extensions or acceleration based on analyses prepared and submitted by other project participants.

Notice that the words “accept,” “accepted,” and “acceptance” are used throughout this document. For consistency, these words are used in lieu of “approve,” “approved,” or “approval.” Regardless of the term used, acceptance typically means that the party providing acceptance takes on the responsibilities associated with that acceptance as defined in applicable contract documents. If the contract documents are silent, then acceptance will generally mean that the schedule as submitted is in compliance with the contract requirements and applicable industry standards. Acceptance, however, does not typically connote a guaranty that the work as scheduled can be completed as scheduled; except for work that is the responsibility of the party conferring acceptance. For example, the owner’s acceptance of the project schedule does not represent an endorsement of the contractor’s plan or confer on the owner an obligation to ensure that the contractor can complete the work as scheduled. That obligation remains the contractor’s. However, depending on the contract requirements, the owner’s acceptance of a schedule may place on the owner the obligation to complete its scope of work as scheduled.

Different aspects of the CM’s time management responsibilities are approached or handled in different ways depending on the stage of the project’s development and execution. Consequently, the discussion that follows focuses on the standards of practice by project stage. The five project phases are pre-design, design, procurement, construction, and post construction.

Pre-Design Phase

The CM’s responsibilities related to time management during the pre-design phase can be summarized as follows:

Master Schedule

Typically, development of the master schedule begins with the CM and the owner agreeing on the overall goals of the project with respect to time. The CM will develop various alternative approaches

for phasing, sequencing, management, and implementation of the design, procurement, construction, and post-construction phases, and discuss these alternatives with the owner. Then, based on the owner's decisions and direction regarding these alternatives, the CM will prepare the master schedule for the project and submit it to the owner for acceptance. This schedule communicates the overall time-related goals in a format that the owner can understand. The schedule format may range from bar graphs or charts for small projects to Critical Path Method (CPM) networks for larger or more complex projects. The accepted master schedule may become an integral part of the Project Management Plan (*See Chapter 2: Project Management | Pre-Design Phase.*).

Typically, once the master schedule is accepted, it is the responsibility of the CM to monitor the progress of the activities on the master schedule and to recommend or take appropriate action when progress deviates from the established plan.

Milestone Schedule

A milestone schedule may be prepared by the CM after the owner accepts the master schedule. This milestone schedule highlights key events from the master schedule, with a particular emphasis on the design phase activities, and may include dates for design professional selection and the other significant steps in the completion of the design professional's scope of work. These dates might include the completion of cost/benefit studies; completion of 30%, 60%, and 90% drawings; completion of design and constructability reviews; the completion of bid packages; and other potential milestones. The milestone schedule may also include dates for the other phases such as the start and finish of the procurement phase or the start and finish of construction. The milestone schedule typically indicates the planned date, based on the owner's requirements, for each milestone activity is to be completed.

Contract Development

The CM may be asked to recommend for the owner's review and acceptance specific scheduling and time extension provisions and requirements for inclusion in the design professionals' contracts. This may include recommendations regarding the milestone schedule dates to be included in these contracts. The CM may also be called upon to make similar recommendations for other contracts, including the contractor's contract with the owner.

Float

The CM should recommend for the owner's review and acceptance specific provisions for the handling of float throughout the various stages of the project. The CM should typically recommend that float be a shared commodity available to all parties to the contract until it is consummated. Coordinating with the owner, the CM should recommend whether float should be determined relative to the scheduled completion dates or dates established in the contract. Related to this, the CM should coordinate with the owner and make recommendations as to how early-completion schedules submitted on the project should be addressed. Once accepted by the owner, the CM should make recommendations as to how best to implement the owner's decisions related to how float is to be determined, how early-completion schedules are to be administered, and float ownership. This may include making recommendations regarding appropriate contract language and explaining this language to proposers or bidders.

Design Phase

The CM's responsibilities related to time management during the design phase can be summarized as follows:

Maintaining the Master Schedule

During the design phase, activities on the master schedule are monitored by the CM. The master schedule is updated to reflect the detailed plan prepared for the design phase of the project. This detailed schedule is typically prepared by the design consultant or other entity responsible for preparing the project design. The master schedule is also updated to reflect the actual progress on master schedule activities on a regular basis, usually no more frequently than monthly, though more frequent updates may be appropriate on short-duration, large, or accelerated projects. As the scope of the project is developed during this phase, the CM makes recommendations for revisions to the master schedule. Such revisions may be the result of changes in the project scope, changes in regulatory or permitting requirements, site investigations, or design phase change orders executed by the owner. For example, revisions may be necessary when time extensions are granted to the design consultant. As provided by the project contract documents, master schedule revisions should be reviewed and accepted by all parties affected by the changes. In particular, all revisions to the master schedule should be submitted to the owner for review and acceptance.

Design Schedule

The design professional or other party responsible for preparation of the project design will typically work with the CM to prepare a realistic schedule for the planning and execution of the design phase requirements. This schedule should be compatible with the master schedule and the milestone schedule and the design professional's contract requirements. Once accepted by the owner, the CM incorporates this schedule information into the master schedule and the milestone schedule.

Monitoring the design phase

Typically, updates or revisions to the design phase schedule will be prepared by the design professional and submitted to the CM for review. The CM will use these updates and revisions to monitor the progress of the project and identify any deviations from the established project plan. Upon completion of its review, the CM will make appropriate recommendations to the owner for disposition of the schedule updates or revisions.

If the CM finds the submitted schedule acceptable, the CM will typically recommend acceptance by the owner. If the CM concludes that the schedule is deficient, typically the CM will work with the design professional to bring the submitted schedule into compliance with the applicable contract provisions and established industry standards. If the schedule submitted shows the project ahead or behind, the CM will make recommendations as to how to bring the schedule into compliance with the project master and milestone schedules or make recommendations regarding revisions to these schedules. This process may include the review of requests for time extensions or acceleration by the design professional. Once the owner accepts the proposed revisions, the CM will typically revise the master and milestone schedules as appropriate to reflect these revisions.

Pre-Bid Construction Schedule

The CM develops a pre-bid construction schedule and identifies major milestones for inclusion in the bidding documents before the contract documents are transmitted to the bidders. The pre-bid

schedule information is provided by the CM as a reasonable estimate of the proposed work sequence, contractual restraints and dependencies, and the contract or project duration based upon the completed design, the CM's past experience, the project status, and other information available at bid time. Appropriate information, requirements and constraints should be noted clearly in the bidding documents and should, once reviewed and accepted by the owner, become a part of the contract documents to be executed by each contractor.

Schedule Reports

The CM should prepare and distribute appropriate reports to the owner and other appropriate parties describing and depicting graphically actual progress on the project during the design phase relative to the project plan as depicted in the accepted master, milestone, and design phase schedules.

Procurement Phase

Contractor's Construction Schedule

The CM should participate with the owner and design professional to explain the project schedule requirements at the pre-bid conference. The CM should explain or clarify for the bidders the pre-bid construction schedule and the contractor's ultimate scheduling responsibilities. The objective is to obtain the contractor's participation in schedule development and maintenance, cooperation, accountability, and compatibility with the overall scheduling and reporting requirements of the contract documents.

It should be the CMs objective to have the successful bidder(s) become part of the project scheduling process. The CM provides a milestone schedule to the bidders and makes them aware of their scheduling responsibilities and obligation to participate in schedule development as required by the contract documents. The CM should explain the requirement for contractor(s) to prepare a construction schedule as provided in the contract documents, including applicable standards, requirements related to content and measurement of float, disposition of early-completion schedules, float ownership, granting of time extensions, and penalties or sanctions related to non-compliance with schedule requirements.

Addenda

The CM should review all addenda to determine the effect on scheduling and time of construction prior to issuance of the addenda. The CM should then recommend to the owner any appropriate revisions to the master schedule and pre-bid construction schedule and, after acceptance by the owner, make changes and distribute the revised schedules to the design professional and all bidders.

Schedule Reports

The CM should prepare and distribute appropriate reports to the owner and other appropriate parties describing and depicting graphically actual progress on the project relative to the project plan as depicted in the accepted master, milestone, and procurement phase schedules (if prepared).

Construction Phase

The CM's responsibilities related to time management during the construction phase can be summarized as follows:

The Initial or Preliminary Schedule

Typically, the CM is responsible to ensure that a schedule is in place for each phase of the project and for each stage of each phase. During the construction phase, development of a comprehensive, detailed project schedule may take several weeks at the beginning of the project. To ensure that some time management tool is in place during this period, the contractor is sometimes required to provide an initial or preliminary schedule for the purpose of establishing the contractor's plan to execute the first actions associated with the project and establish a tool by which the CM may monitor the progress of the project during the period when the baseline project schedule is being developed. The CM will typically be tasked with ensuring that the contractor fulfills its obligations under the contract as it relates to these schedules and recommending appropriate actions to the owner in the event the contractor fails to meet its obligations. It is important for the CM to fulfill its own obligations relative to enforcing the contract requirements regarding the provision of an initial or preliminary schedule as these schedules become the tool for planning the earliest stages of construction, monitoring the contractor's initial efforts, and addressing any deviations from the anticipated plan, including evaluation of delays and determining entitlement to time extensions.

The CM's responsibilities as they relate to the initial or preliminary schedule are similar to its responsibilities throughout the construction phase of the project:

- The CM is responsible to ensure that the construction contract requires the contractor to develop and submit an initial or preliminary schedule for acceptance prior to beginning construction. These requirements include identifying software or electronic submission requirements to ensure that the initial and preliminary schedule submissions are compatible with the master schedule software.
- The CM will then monitor the contractor's performance to ensure that the contractor makes a timely submission of the initial or preliminary schedule.
- If the contractor fails to submit the initial schedule as required by the contract, the CM will inform the owner and make recommendations as to how the contractor's failure should be addressed.
- Upon submission of the schedule, the CM will review the schedule to ensure compliance with the contract requirements and make recommendations to the owner regarding acceptance.
- If the schedule is not acceptable to the CM, the CM will make recommendations to the owner regarding how to address the contractor's submission.
- Once accepted, the CM will monitor the contractor's performance with regard to the initial schedule, notify the owner of any deviations, and make recommendations to the owner regarding how to address these deviations.
- If the baseline schedule has not been accepted within approximately two weeks of the expiration of the initial or preliminary schedule, the CM should make recommendations to the owner regarding how to address the impending deadline. These recommendations could involve the contractor's submittal of an extension to the initial or preliminary schedule. This submittal should go through an acceptance process similar to the original submission of the initial or preliminary schedule.

The Baseline Schedule

The CM plays a central role in the development, acceptance, implementation, and monitoring of the baseline schedule for the project. As with the initial or preliminary schedule, the CM typically assumes the responsibility to advise the owner as to how scheduling and time management on the

project should be accomplished. This portion of the CM's responsibilities is typically accomplished in earlier phases, usually during design or procurement. During the construction portion of the project, the CM is then typically responsible to fulfill its obligations related to time management as established in earlier phases. With regard to the baseline schedule, these responsibilities typically include the following:

- Making appropriate recommendations regarding the contractor's time management and scheduling responsibilities in the contract.
- Monitoring the contractor's performance regarding the development of the baseline schedule, and making recommendations to the owner regarding actions to take when the contractor deviates from its scheduled performance.
- Reviewing the contractor's baseline schedule submissions to ensure compliance with the requirements of the contract and applicable industry standards, and making recommendations to the owner regarding the actions to take regarding the contractor's submission.
 - These actions might include acceptance, or a recommendation to reject the schedule, an accompanying description of schedule deficiencies, and, where appropriate, recommended corrections.
 - The CM must also ensure that the contractor adequately considers all the parties involved with the execution of the project so that the accepted baseline schedule becomes the plan for the project team, not just the contractor.
- The CM's responsibilities typically include monitoring of actual events in relation to the dates and durations on the accepted schedule. Under some contracts, these responsibilities might also include schedule updating. If, for example, the owner decides to act as its own general contractor, is self-performing a substantial amount of the work, or is fast-tracking the work with multiple contractors, or when construction is only a small piece of a much larger effort, the owner may be willing to trade the added responsibility (and risk exposure) that goes with owning the schedule for the greater control that comes with determining the sequence and pace of the project. Under these conditions, the CM could be tasked with developing, updating, and revising the project schedule as these responsibilities are delegated by the owner.

Schedule Updates

To allow effective time management, the project schedule must be used by the CM to plan and execute its work and to fulfill its obligations to monitor the performance of the other parties involved in the execution of the project. To remain valuable as a planning and monitoring tool, the schedule must be kept current. Typically, this means that the CM recommends to the owner and then helps the owner implement a process by which the project schedule is periodically updated.

For the purposes of this discussion, updating is limited to the incorporation of actual performance information related to the activities in the schedule; for example, the actual start and finish dates for schedule activities and minor revisions to schedule logic and durations. Minor revisions are defined for the purposes of this document as revisions that do not result in earlier or later scheduled completion dates for project milestones or do not appreciably affect the obligations of other parties to the project.

The CM's responsibilities related to schedule updates are similar to those for the baseline schedule. However, in addition, the CM will review the progress of the project against the accepted schedule to ensure that the contractor is accurately updating the schedule and also to advise the owner of deviations from the accepted plan depicted in the schedule update.

Schedule Revisions or Revised Schedules

Very few projects are completed exactly as planned. For this reason, there is often a need to make revisions to the accepted schedule in order to maintain a current and accurate time-management plan for the project team. These revisions reflect the decisions made by the project management team in response to project conditions. These decisions, when they are more than simple corrections of out-of-sequence logic or other small and insignificant adjustments, may necessitate more substantial revisions to the schedule. The process of incorporating these substantial changes is typically known as revising the schedule. When a revised schedule is necessary, the CM should treat the situation similarly to the submission of the baseline schedule given its potential to affect decisions made by the owner and other stakeholders involved with the project. The CMs' role in the process is crucial:

- If other parties do not recognize the need for revision first, it is the CM that must recognize the need for revisions to the project plan and provide the owner with recommendations as to how to address this need.
- Once the need to make revisions to the plan is recognized by the project team, the CM's responsibilities are similar to those related to the initial schedule, baseline schedule, and schedule updates.
 - The CM keeps the owner informed of progress on the development of the revised schedule and makes recommendations when this process falters.
 - The CM reviews any submissions made to ensure compliance with the contract and makes recommendations to the owner regarding acceptance or rejection of these submissions.
 - Upon acceptance, the CM then shifts its focus to the revised schedule for the purposes of monitoring the project team's performance.
- If the contractor is seeking a time extension, whether as a part of the schedule revision process or not, the CM's preference should be that time extensions be negotiated and agreed to before the associated delay actually occurs. This means that the CM must be alert to problems that might cause a delay before they occur. Most commonly, this will be possible when the owner is contemplating a change and the project team has time to consider the change before actually making a decision to proceed. Regardless of the timing of the delay, the CM's responsibilities are similar:
 - The CM ensures that the appropriate party is conducting the necessary analysis to determine the magnitude of the delay and the party responsible.
 - Once a submission is made, the CM reviews the submission to ensure that it correctly establishes the time extension due, if any.
 - Upon completion of its review, the CM makes recommendations to the owner regarding how to proceed: whether to accept the submission and execute an extension of time, acknowledge responsibility for the delay but consider acceleration to mitigate, or reject the submission with an appropriate basis.

Each of these types of schedules will be evaluated as discussed later in this section, and recommendations will be made regarding the rejection or acceptance of the submitted schedule. It is

important that the CM maintain independence and objectivity. It is also important that the CM maintain its role as defined by the project's contracts and not assume the roles or responsibilities contracted to others. This ensures that the appropriate party fulfills its scheduling responsibilities and reduces the risk to the CM and the owner associated with usurping the planning and scheduling obligations of the contractors.

Maintaining the Master Schedule

During the construction phase, the CM also monitors activities on the master schedule. The master schedule is updated to reflect the detailed plan prepared for the construction phase of the project. The master schedule is also updated to reflect the actual progress on master schedule activities on a regular basis, usually no more frequently than monthly, though more frequent updates may be appropriate on short-duration, large, or accelerated projects. Based on the detailed construction phase schedules, the CM makes recommendations for revisions to the master schedule. As provided by the project contract documents, master schedule revisions should be reviewed and accepted by all parties affected by the changes. In particular, all revisions to the master schedule should be submitted to the owner for review and acceptance.

Schedule Reports

The CM should prepare and distribute appropriate reports to the owner and other appropriate parties describing and depicting graphically actual progress on the project relative to the project plan as depicted in the accepted master, milestone, and construction phase schedules.

Post-Construction Phase

Occupancy Plan

The CM may develop an occupancy plan that provides the owner with a smooth and orderly transition into the completed project and facilitates revenue income or beneficial use as quickly as possible. The occupancy plan should include participation of contractors, system start up, completion of punch lists, city/state/federal reviews and certification, and move in of the owner's staff or tenants. The CM should submit its occupancy plan to the owner for the owner's review and acceptance. Once accepted, the CM should incorporate the occupancy plan into the master and milestone schedules for the project. Thereafter, the CM should monitor the performance of work during the Post construction phase, update the occupancy plan as appropriate, provide recommendations with regard to any deviations from this plan, and provide appropriate reporting.

Chapter 5: Quality Management

Introduction

This section presents the key goals, philosophies and elements of providing services while enhancing quality in the planning/design/construction process, the Construction Management services and ultimately, in the constructed facilities.

Definitions

Project Procedures Manual (PPM)

A written, project-specific plan that outlines the project's scope, organization, and the specific approach to be undertaken to accomplish the various management tasks for the project. These quality management guidelines should be integrated into the various sections of the PPM to maintain a focus on project quality. On certain large projects, it may be appropriate for the CM to prepare a separate Quality Management Plan (QMP) which elaborates upon the quality guidance aspects of the PPM.

Quality

The degree to which the project and its components meet the owner's expectations, objectives, standards, and intended purpose, determined by measuring conformity of the project to the plans, specifications and applicable standards.

Quality Management (QM)

The process of planning, organizing, implementing, monitoring, and documenting a system of management practices that coordinate and direct relevant project resources and activities to achieve quality in an efficient, reliable, and consistent manner.

Quality Control

The continuous review, certification, inspection and testing of project components, including persons, systems, materials, documents, techniques and workmanship to determine whether or not such components conform to the plans, specifications, applicable standards, and project requirements.

Quality Assurance

The application of planned and systematic examinations or verifications which demonstrate that quality control procedures are being effectively implemented.

Regardless of the level of effort required by the CM's contract, quality management is an inherent element of the CM's basic service. Therefore, the CM should encourage the owner to develop and

implement a comprehensive Quality Management Plan as one of the first project tasks undertaken, whether the CM begins providing services during the pre-design phase, after construction has begun, or at any time in between.

Pre-Design Phase

Goal

The goal during this phase of the work is to establish a program of quality management that will endure throughout the life of the project.

Clarifying Owner's Objectives

The CM should meet with the owner to clarify the expectations, goals and objectives of the quality management program. It is important that the owner understand the underlying concepts of a quality process, quality services, and a quality project. Costs and benefits should be explained.

Scope of Work

The CM may review to see that the scope of work for the design professional clearly outlines the various elements of the proposed services as accepted by the owner. The criteria by which the success of the completed project will be measured must be defined and clearly understood. This forms the basis for the Quality Management Plan. Consistent with CMAA guidelines, the CM should review the design professional's contract for conformity with expected quality standards and related project criteria including, but not limited to inspection/testing, sustainability, risk assessment and commissioning. Prior to starting any work activity, the design professional should identify all quality-related design criteria and assure that these criteria are acceptable to the owner.

Project Organization

The quality management organization should include key representatives of the design professional, CM and owner, preferably at the executive level, who will be responsible for the implementation of quality control and assurance initiatives.

Quality Management Plan (QMP)

The CM should develop a comprehensive Project Quality Management Plan, with direct input by the design professional and the owner.

The Quality Management Plan should identify the various steps in design development leading to approvals by the owner, users, government agencies, affected utility companies, and other agencies having jurisdiction over the project. The Plan should also provide for senior level design professional review of design criteria, calculations, drawings, and specifications.

The Quality Management Plan should be reviewed by all parties and modified as required and then agreed to in a formal sign-off procedure. A modification procedure should be developed for subsequent revisions to maintain a current and effective plan.

Design Phase

Goal

The goal of this phase is to assure the implementation of the QMP in order to achieve a set of

contract documents that support a successful procurement activity and ultimately the completion of the project in accordance with all of the project quality requirements.

Document Control

The CM takes action to see that a document control system is established during the design phase. This system provides for the orderly logging of design progress submissions for each individual contract, with a tabulation of approved plans to be advertised. The document control system is also applied to plans after bids are received, to conformed sets of plans illustrating all official addenda, and to change order plans during construction.

Review of Design Submittals

The CM should develop and implement a process so that all participating parties are given the opportunity to review design submittals as they are developed, and an opportunity to verify that quality objectives are being achieved.

Design Criteria Changes

Design criteria changes, when directed or required and mutually accepted, should be documented by the design professional in letter, email or memo form to the owner, with copies to the CM.

Quality Control

The design professional should proceed with design activities in conformance with the Quality Management Plan. This process involves methods to check concepts, calculations, and material selection procedures so that the level of quality expected by the owner or required by the contract is being achieved. Plans and specifications are to be reviewed for clarity, completeness, testing/documentation requirements and consistency.

Quality Assurance

A Quality Assurance Plan, as part of the Quality Management Plan, should be followed by the design professional, including the systematic reviews which demonstrate that quality control activities have, in fact, been undertaken in an acceptable manner. Reports of items requiring corrective action should be maintained in a separate log for follow-up review and action prior to completion of design. The CM provides oversight review of the design professional's QA efforts on behalf of the owner. Collaboration should be implemented with all project stakeholders to effectively and efficiently implement the Quality Assurance Plan.

Building Information Modeling (BIM)

The CM should assure that the owner has considered using Building Information Modeling for the project. This 3-D CAD process, to promote design coordination of various project elements, quantities, clash detection and craft activities, has a proven track record of significant efficiency, quality improvement, and reduction of rework for construction projects. When authorized and implemented, the CM shall assure that appropriate BIM information is implemented for the project.

Constructability Reviews

The CM develops a specific constructability review program for inclusion in the Quality Management Plan. The constructability reviews should include, at a minimum, a detailed review of the schedule, milestones, and constraints associated with the work, a field visit to confirm existing conditions have been considered in the design, and a detailed review of plans and specs to assure they are clear and coordinated. It is recommended that constructability reviews be conducted at the

30 percent, 60 percent, and 100 percent completion stages of contract documents. Constructability reviews should also consider availability of materials, availability and capabilities of local trades and other local market conditions. The review should also confirm that the documents are suitable for bidding purposes.

Sustainability

The CM should assure that the owner has considered sustainability goals and objectives for the project. The project's sustainability expectations and the CM team's sustainability qualifications must be set as early as possible to ensure alignment of expectations with roles and responsibilities among all the project stakeholders. When implemented and included in the Quality Management Plan, the CM shall assure that the owner has established clear criteria for the sustainability scope of work, phases of implementation, team responsibilities and expected outcomes and implications, be they fiscal or schedule or otherwise.

Value Engineering

The costs and benefits of a formal value engineering analysis should be discussed with the owner and if the owner agrees, provisions for a formal value engineering analysis should be included in the Quality Management Plan at various stages of the Work. A Certified Value Specialist (CVS) should be retained to lead these reviews.

Risk Management

The CM shall assure that the owner has been made aware of the benefits to develop a Risk Management Plan for the project. When included in the Quality Management Plan, the CM shall assure the Risk Management Plan is implemented, including measurement and reporting to the owner.

Establishment of Construction Duration

The construction duration should be established with activity durations based on documented experience, historical data or other recorded information, resulting in a pre-bid schedule being established in a CPM format.

Construction Testing Requirements

The design professional should detail specific tests expected to be performed by the contractor or supplier on the site and in fabrication plants. Any material or product certifications which are required and/or are acceptable in lieu of tests should be noted. The responsible party, testing requirements and the acceptance criteria should be clearly identified in the contract documents for all elements of construction.

Quality Management Specifications

The CM should develop quality management specifications in which the contractor's QA/QC responsibilities are identified, including organizational requirements for QA/QC. On larger projects it is as desirable to require the contractor to implement a written QM Plan. The Quality Management Plan should identify when quality management specifications are required as a part of the contract documents. The CM should confirm these specifications are included in the contract documents when required.

Implementation of QC/QA Requirements During Construction

The contract documents may include the specific requirements for a contractor's Quality

Management Plan. In the QM specifications, specific submission requirements are outlined dealing with contractor quality control activities and quality assurance efforts. The CM should assure the requirements are implemented. The contractor's performance of quality control and quality assurance activities can be a requirement for progress payments.

Public Relations/User Review

The CM should facilitate the user's understanding of the design documents. Depending on the nature of the owner's organization, it is often appropriate to involve the project's ultimate users in periodic reviews of the design as it progresses. On public projects the CM may assist in the development of a task force of public representatives to review and discuss various aspects of the project. On private projects, a task force of key personnel from the user group may be consulted through various presentations as the design develops.

Project Funding

The CM may verify that the necessary project funding has been authorized and that all fiscal requirements have been, and will continue to be, met, including the allocation of appropriate funding for activities which specifically impact on the quality of the project.

Project Review Meetings

Project review meetings can be conducted, no less than monthly, during the design phase of the project and continue through completion of work, with the key project participants in attendance. quality assurance and quality control of the design should be reviewed and discussed as a part of the project review meeting.

Reports

The QM Plan should designate the various design reports required of the design professional during the design phase, such as foundation assessments, geotechnical report, etc.

Procurement Phase

Goal

The goal of this phase is to conduct the procurement process in a manner that will comply with all internal and external quality requirements, secure contractors and suppliers capable of satisfying those quality requirements, and result in the successful and timely award of contracts for construction.

Procurement Planning

The CM establishes the goals for the procurement phase as a part of the QM Plan. The Master Schedule, as outlined in the Time Management section of the Standards, should be consulted. The CM should review the Master Schedule procurement cycle for advertisement, bid and award, together with any special approvals during the award cycle to assure the schedule reflects market conditions and is reasonable.

Advertisement and Solicitation of Bids

The CM should comply with prescribed standards for public agencies and private owners and propose any modifications to allow consistency with the Quality Management Plan for the project. The CM should participate in all pre-bid meetings, site visits, and addendum preparation.

Select Bidders List

Many owners identify and pre-qualify bidders they believe are qualified to pursue work in their market through special lists. The CM should assist the owner in managing any prequalification steps or establishing standards which are appropriate prior to any advertisements for bids.

Instructions to Bidders

The Instructions to Bidders section of a solicitation should be comprehensive and include clear, concise information which complements the advertisement or solicitation statement. The CM should review the instructions to assure this goal is reasonably achieved. Instructions should advise the various offerers of the procedures and requirements to submit an acceptable proposal for the owner's review.

Pre-Bid Conference

A pre-bid conference should be held for each contract being solicited by an owner. The CM should chair this conference or support the owner's project manager in this task. Key participants should be introduced at this time to the bidders present including the owner and his staff, the design professional and the CM. Pertinent schedule information should be reviewed by the CM, including Master Schedule information if part of a multi-project program. Site visits are suggested and may be mandatory. The CM should record minutes of the pre-bid conference and site visit. All direction that supplements or differs from the solicitation documents provided to bidders resulting from the pre-bid meeting must be issued by addendum.

Proposal Document Protocol and Bid Opening

Information regarding the forthcoming contracts, prior to and during bid, must be controlled in a manner that does not allow any bidder an unfair advantage over others. The CM, design consultant and owner work together in exercising caution and good judgment in maintaining the "level playing field" required for uniform and fair bidding. At bid opening the owner and CM representative, if applicable, should open all bids received and record the information, unless otherwise proscribed by statute.

Pre-Award Conference

The owner and CM should conduct a pre-award conference with the apparent successful bidder to review and discuss the terms, conditions, costs and scope of work. The conference could be a personal meeting with the parties, or via telephone, depending on the issues involved and should be structured to assure all parties have clear understanding of the contract and scope of work.

Contract Award

The owner or CM should formally notify the successful bidder by letter that they have been identified as most responsive bidder for the contract or have been otherwise selected to perform the work. This letter should be recognized as the "Notice of Intent to Award," by the owner. After receiving this notification the contractor is again advised by the CM of the requirements to provide necessary bonding, insurance, and other special requirements set forth in the instructions for bidders and contract documents.

Construction Phase

The following discussion focuses on the various quality initiatives that should be incorporated into the construction phase of any project. It should be reviewed in conjunction with the specific

information set forth in this Standard of Practice and be integrated in the preparation of the detailed Quality Management Plan for each specific project.

Goal

The goal of this phase is to complete the construction in accordance with the quality requirements of the contract documents, with documentation to verify that such compliance was achieved.

Preconstruction Conference

The Quality Management Plan should require a preconstruction conference, attended by the contractor, owner, CM and design professional, to review and discuss the overall project. This conference is held after Notice of Intent to Award is made to the contractor but prior to the Notice to Proceed. At this time, the contractor should present to the owner's team the general approach including quality control to the project, while introducing the contractor's key personnel.

Construction Planning and Scheduling

To enhance quality regarding construction time, the contractor must submit a detailed schedule for the work. This schedule may be viewed as the plan by which the contractor guarantees that the work will be performed within the construction time set forth. Construction milestones should be addressed by the contractor in his schedule submission, as identified in the contract documents. This schedule should be reviewed and approved for use by the CM to verify its compliance with contract requirements.

Inspection and Testing

Consistent with the Quality Management Plan and the CM's contract, the CM verifies that testing and inspection of the contractor's work, on a daily basis when appropriate, is being accomplished to determine whether or not the work is being performed in accordance with the contract specifications. If the CM is providing such services, the Quality Management Plan provides for the quality control and assurance mechanisms to ensure the quality of the services.

Reports and Recordkeeping

The CM should maintain thorough documentation of daily inspection efforts for the project. In addition to inspection reports, records are maintained of all pertinent project data and correspondence on the project, progress photos and photos of existing conditions prior to the notice to proceed. Correspondence would include all submissions by the contractor, approvals by the owner, shop drawing submissions, logs, certifications, etc.

Changes in the Work

The general conditions or special provisions of the contract set forth the specific requirements to document and obtain approval by the owner of any changes in the work. The CM is routinely charged with the responsibility to review and assess any authorized extra work under the contract as to its effect on construction time, cost and quality.

Document Control and Distribution

The CM establishes procedures for document control and distribution of approved contract plans and specifications. The CM should issue all changed drawings, sketches, plans, etc. A log should be maintained of all current documents.

Non-Conforming and Deficient Work

The Quality Management Plan should state the specific requirements for quality control and quality assurance. The contractor(s) should systematically review quality control efforts by his forces. Periodically, items will be identified which are not in conformance with the contract specifications. A log must be maintained by the contractor(s), with copies to the CM, of all such items, until they are removed from the log as a result of an acceptable action by the contractor(s).

Progress Payments

The CM should propose an acceptable progress payment process to the owner, unless one exists within the owner's existing plan of operations. The progress payment format should be prepared to accurately represent all costs associated with the project, all current change orders and contingencies.

Final Inspection, Documentation and Punch List Work

Towards the end of the project, the contractor(s), by specification requirements, may request a final inspection of the work to determine if the work can be declared substantially complete. If in the opinion of the CM the work is sufficiently complete, a final inspection shall be conducted by the CM, attended by the contractor, designer and owner, and a punch list of outstanding items shall be developed by the CM. If all remaining punch list items are inconsequential to beneficial occupancy, the contract may be declared substantially complete. After acceptable completion of all outstanding items, the contract may be accepted as complete.

Commissioning

A formal commissioning plan should be prepared and implemented. The plan should identify the equipment and systems to be commissioned. Each item should be tested under various levels of performance to demonstrate capability to meet and sustain the system/equipment design. Reports should be issued documenting these activities. The CM should monitor to assure implementation of the commissioning plan.

Beneficial Occupancy

This term and provisions for its use should be defined in the contract specifications. Generally, it represents the time that a particular facility, structure, or area is taken over for use by the owner for its intended purpose. The quality of the facility, structure or area should be assessed by the CM to determine if it is reasonably acceptable for beneficial occupancy. This may occur before all work of the contract is complete.

Substantial Completion

This term should be defined in the contract specifications. Generally, it represents recognition by the owner that the project is ready for occupancy or use in accordance with its intended purpose. Certain minor punch list items which do not hamper the use of the facility to the owner may be completed within a reasonable or specified date after substantial completion. The specified level of quality should be achieved for accepted elements of the work at substantial completion.

Final Acceptance

Final acceptance of the work generally requires the owner to issue a "Certificate of Final Acceptance" to the contractor for the work and to file a Notice of Completion. This states that the contract is completed with no outstanding items remaining. This is also the milestone by which the contractor will notify his bonding and insurance companies that no further obligations remain on the contract.

Post Construction Phase

The achievement of quality during the post construction phase is largely a function of earlier planning completed, preparatory actions initiated in the previous phases of the project, and expedient project close-out.

The Quality Management Plan can require that the CM assist the owner in the review and implementation of operations and maintenance manuals associated with equipment installed and assist in pre-warranty expiration date checkouts.

QM Assessment with Owner

After the project is completed and all CM Services are nearly complete, the CM may review and discuss the overall quality management of the project with the owner. It is recommended that a detailed discussion be held with the owner and his key representatives to objectively assess the efforts which were conducted on the project and the benefits derived. This allows all parties to build upon the experiences encountered during the course of the project in a manner that would enhance quality in forthcoming work.

Final Report and Recommendations

The CM prepares a final report for the overall project with recommendations to the owner regarding activities during the course of work which may require re-evaluation for future work. These services should be provided for in the CM contract, developed with the owner at the start of work.

Chapter 6: Contract Administration

Introduction

This section addresses the administrative tasks of the CM during project execution and the administration and reporting requirements for all construction contracts.

Pre-Design Phase

Communication Procedures

The CM should develop procedures for recording and controlling the flow of submittals by the designer for approval by the owner. The CM should establish the systems and procedures for communications among the owner, designer(s) and CM over the course of the project.

Design Phase

Goal

The goal during this phase of the work is to assist in achieving a complete a set of documents defining a cost-effective project that will result in competitive bids in the current market within the owner's established budget, performance, and time requirements.

Design Phase Progress

The CM develops and implements a system for information flow to all project team members concerning design progress during this phase. The CM should apprise the team of any actual or potential constraints to the project goals and make written recommendations for corrective action.

During the entire design phase the CM maintains a process of review and consultation among team members on all relevant issues.

Design Review Meetings

In order to expedite the design reviews, the CM should provide for the flow of comments and owner approvals. A written record of comments and their disposition should be compiled, and the CM should act to see that minutes of all meetings are properly distributed.

Schedule Maintenance Report

Once the Master Schedule and Milestone Schedule have been prepared, the CM initiates a schedule maintenance report. This report is intended to monitor the project schedules and compare the actual progress, particularly of critical dates, against the scheduled progress. It is recommended that this report be issued on a monthly basis.

The schedule maintenance report is to be objective and include recommendations for correcting delays or incorporating changes that occur in the original or adjusted plan. This report should be timely, and prepared so as to portray the actual work conditions and project forecasts accurately.

Project Cost Report

The CM prepares a project cost report to compare the budget for the project to the actual costs incurred and the forecast to complete. The initial project costs are conceptual, but become more empirical as the project is defined and then constructed, until final actual costs are recorded. The comparisons should be recorded on the changes that occur in the project budget due to design development or scope changes that are initiated by team members. Minor variations to the original scope or Project Management Plan should be noted during project meetings. Major changes that affect time and/or cost are noted by issuing a change and/or a budget amendment, as may be required. The cost report should specify estimated cost compared to the project and construction budgets.

Procurement Phase

Goal

The goal in this phase is to assist in securing for each bid package a sufficient number of bidders, including subcontractors, who are qualified, competitive, interested in the work, and capable of doing the work within the project time and budget requirements.

Bidder Prequalification

Prior to any bidder prequalification that may be required, the CM may develop a contract scope breakdown for each contract on the project. The breakdown should consider availability of design information, schedule, and local contracting practices. In conjunction with the scope development, schedule information should be produced which includes key dates for receiving technical information, reviews and approvals, bidding, evaluation, and contract award.

In conjunction with establishing bidder lists, the project invitation, or request for bids, and other documents to be used for contracting should be developed by the CM and approved by the owner.

Development of Bidders List

The CM should assist the owner in developing the list of potential bidders and in prequalifying bidders.

Project bidding may be open to all interested bidders or to only prequalified and approved bidders, depending upon the owner's requirements. In an open bid environment, the CM should evaluate the bids for competitiveness, responsiveness and ability of the bidder to do the work. The CM should also confirm that the bidders are responsible and are financially strong.

For closed bidding, the CM should develop the criteria for bidder selection in consultation with the owner and the designer.

It is recommended that this activity be initiated during the design phase, as the type and availability of contractors are factors in consideration of some design elements and bid packaging.

Bidders Interest Campaign

The CM should conduct a telephone and/or a written campaign to generate maximum interest among qualified bidders without bias or prejudice towards any firms. Information received from the bidders should be recorded formally and presented with other data used in determining the bidders list.

Notices and Advertisements

When the owner desires to have open bidding in lieu of a selected bidders list, notices and advertisements are required. The CM should assist the owner in the preparation and placement of such notices. Usual placements are in trade journals and newspapers in the desired trade areas. Sufficient time must be allowed to ensure response from interested bidders.

The notices should be clear as to scope of work and schedule, as well as the steps necessary for obtaining bidding documents. Care must be exercised to follow specific notice requirements for public bidding.

Delivery of Bid Documents

The CM should administer the distribution of bid documents, in coordination with the designer. The CM should verify that all interested and/or qualified bidders receive the appropriate bid documents and maintain records of all transmittals.

Information to Bidders

The CM should develop and coordinate procedures to provide answers to bidders' questions and to issue addenda in a timely manner within the prescribed bidding period. The team members must be cognizant of the content and approve each addendum issued.

Addenda

The CM should review addenda and coordinate their issuance with the designer and owner in the same manner as exercised with the bidding documents. The bidders should be made aware of any issue in advance, and addenda must be received and acknowledged by bidders in time for adequate review and response.

Pre-Bid Conferences

The CM may be responsible for conducting the pre-bid conferences. These conferences are intended to be a forum for explanation of project requirements concerning schedule, access to the site, time constraints, owner's administrative requirements, and technical information pertaining to the project. The CM, owner and designer should be prepared to accept questions from bidders and respond in writing prior to bid closing. Minutes of these meetings should be recorded and officially issued to all bidders.

A site tour is conducted by the CM as part of the pre-bid conference to afford all bidders first-hand knowledge of site conditions and any constraints.

Bid Openings and Evaluation

Bid openings may be structured as private or public, depending upon project requirements. The unopened sealed bids should be held in tight security. The CM may assist the owner in recording bid receipt times in a formal procedure. At the established time, the bids should be opened and recorded on a bid comparison form similar to the bid form. The CM may assist in evaluating the bids for

completeness, responsiveness, and pricing and should coordinate this evaluation with any technical review that may be required by the designer. All bidder exceptions and clarifications should be resolved by the CM in a manner suitable to the owner. Early bids should not be opened prior to the designated time, and late bids should be formally returned unopened.

Any recommendations made by the CM for contract award should be in writing, giving the reasons for the decision and including copies of the bids and bid comparisons for the owner's use.

Post Bid Interview

The CM may conduct the post bid interview to discuss the proposed contract with the bidder to whom award is anticipated, to be certain there is clear understanding of project scope, and to discuss any bid alternatives the bidder may have submitted. The CM should confirm the absence of any bid errors and inform the bidder of the permit requirements, as well as the required insurance documents and labor affidavits, quality issues and any special requirements of the contract documents. Items discussed should be documented.

Construction Contracts

After owner approval of the successful bidder(s), the CM, if requested by the owner, should assist in the execution of the construction contract(s).

Schedule Maintenance Report

The CM's schedule maintenance report should compare the actual bid dates against the proposed bid dates from the Project Management Plan. Should the actual bid dates indicate schedule impact, the reasons and effects should be explained. On some projects, the schedule maintenance report is combined with the construction schedule report.

Project Cost Report

The project cost report should be updated by the CM to indicate actual bid prices compared to budget figures for each contract. An analysis of the impact of bid amounts should also be included. The team members now have actual cost information to compare against the Project Management Plan budget.

Cash Flow Reports

As with the project cost report, the cash flow report reflects a greater accuracy in predicting expenditures, since it is based on actual bids rather than budget figures. This report should be produced monthly by the CM unless the owner desires a longer time span.

Construction Phase

Goal

The goal in this phase to expedite and improve the efficiency of the construction process through professional planning and execution of project activities, all focused upon fulfilling the owner's scope, cost, quality and time requirements.

Permits, Insurance, Labor Affidavits, and Bonds

The CM monitors the progress of contractor(s) in securing and maintaining proof of insurance, necessary building permits, insurance, labor affidavits, and bonds.

Pre-Construction Orientation Conference

The CM should call a meeting of the project team and interested parties to discuss the requirements of the contract, the contractor's approach, and to review the administrative and other reporting procedures required prior to issuance of a Notice to Proceed. The CM should prepare an agenda and conduct this meeting prior to the contractor(s) moving onto the project site. Minutes of the meeting should be taken and distributed to all parties.

Notice to Proceed

The CM should issue Notice to Proceed to the contractor once it is confirmed there are no outstanding issues that could delay the commencement of work.

Assignment of Owner-Purchased Equipment and Materials

The CM may assist the owner in the transfer and acceptance by the contractor(s) of any owner-purchased materials and equipment. This equipment should be assigned, or title legally transferred, to the contractor responsible for installation.

On Site Communication Procedures

The project team must function effectively and expeditiously during the construction phase. The CM should prepare communication procedures to be used on site, such as:

- Project directory
- Communication flow chart
- Contractor correspondence files
- Chain of responsibility and authority
- Submittal flow chart and logs
- Field orders
- Coordination meetings
- Quality assurance/quality control
- Shop drawings
- Substitutes
- Directives and reports
- Cost and schedule performance data

Project Site Meetings

To manage the construction activities effectively, the CM should organize, conduct, and record regularly scheduled meetings involving the CM, contractor's supervisory personnel, the designer and the owner, as required. Purposes of these meetings should be to:

- Discuss medium and long range plans for contractor(s).
- Discuss and resolve any scheduling/coordination problems of or between contractors.
- Obtain answers and clarification to any questions the contractor(s) may have of the designer and/or set direction for obtaining that information on a timely basis.
- Review and approve monthly payment requests.
- Coordinate long lead item procurement.
- Resolve any other issues that may be brought to the group.

Dissemination of the minutes of these meetings should be timely in order to realize full value of the discussion and resolutions achieved. Minutes of individual contractor meetings should be distributed to the project team members.

Contract Documentation Procedures

The CM should distribute to all involved parties the information that is important to their project responsibilities. The CM should establish recording systems for receipt, handling, and distribution of the following:

- Contract documents
- Contractor requests for information
- Owner's directives
- Designer's directives
- Submittal receipt and approvals
- Changed conditions
- Claims
- Meeting minutes
- Project periodic reports
- Daily field reports
- Payment requests
- Photographs

Field Reporting

The CM's on-site staff should provide daily written reports of project activities including, as a minimum requirement, the following:

- Weather conditions.
- Contractors working and number of workers representing each contractor and subcontractor.
- Project visitors.
- Significant materials and equipment received.
- General description of each contractor's activities and brief discussion of any specific problems, their resolution or direction set for resolution.
- Project delays or potential delays.
- Contractor's on-site equipment and utilization.

Quality Review

The CM should establish and administer the procedures by which the quality of the project is assured. Quality review under Construction Management becomes a common pursuit of all team members on the project. The CM should work with the owner and design professional to develop a Quality Management Plan (QMP) for each project as described in Section 5 of this manual. The on-site function of the CM does not, in any way, mitigate the contractual obligation of the contractor to provide quality performance. The contractor is solely responsible for the quality of work.

It is recommended that the contractor be required to provide, as a QC program, a written description of how to meet the quality requirements. Each program should include the mandatory inspections and testing in the specifications, as well as any other inspections, tests or procedures that

are necessary to meet the requirements of the contract documents. In some contracts the QC programs are very detailed and involved; in other contracts they consist of a statement committing the contractor(s) to the procedures described in the specifications. In administering the contractor's QC program, the CM's role is one of fairly and impartially implementing the owner's requirements as stipulated in the contract documents.

The CM should coordinate field-testing and inspection which is not a part of the contractor's work scope. This interface must be carefully considered and defined at the time of bid packaging and further described in the project QMP.

Nonconforming Work

Should the CM discover that the contractor(s) work fails to conform to the contract documents, the CM should:

- Notify the contractor in writing of non-conforming work and seek corrective action;
- Inform the owner and designer.
- With the designer's input, determine if correction of the work in question can best be achieved by removal or rework, or by owner acceptance, subject to credit.
- Recommend that payments not be made for nonconforming work.
- Follow-up until a satisfactory solution is reached.

Prompt detection of nonconforming work is no more important than prompt disposition of the finding. The longer a resolution is delayed, the more expensive is its effect on the project. The normal resolutions of "replace," "rework," or "accept-as-is" should be quickly analyzed and priced and the approved disposition communicated to the contractor with the payment terms to be applied to it.

Safety

The development and application of a safety program for each contract is the responsibility of the contractor(s) who has the direct control of the work forces and control of methods and means of construction. The CM may be responsible for review and verification that the contractor has a program and that the programs are coordinated. (*See Chapter 7: Safety Management.*) The CM should not be responsible for contractor implementation or compliance with contractor safety programs.

Change Order Report

All change orders should be reported in an overall change order report to reflect transactions and current status. This report may be issued monthly and the net effect on the original or current construction budget and Master Schedule noted. Both the owner-approved change orders and the known potential changes may be recorded so that the team members are totally cognizant of the cost status of the project.

Expedition handling of change orders helps to prevent claims. Resolution of changes in the work should be handled on a timely basis and coordinated with the designer as required. This routine will encourage cooperation by contractors and awareness by the owner.

Force Account

The CM should, at the owner's request, monitor and maintain cost records of expended labor,

material and equipment for purposes of establishing cost for claims and/or change orders for which a pre-agreed price could not be reached.

Complete and accurate records should be kept of “time and material” or “cost-plus” work for invoice verification, as well as establishment of cost.

The contractor(s) should be required to submit a daily time sheet to the CM for approval as well as documentation for all material and equipment purchases and renewals required to complete the task. These CM approved documents should support and accompany the contractor’s invoice requesting payment for a task or partial progress billing.

Cash Flow Projection Report

The CM should establish a cash flow reporting system. The system should provide for timely reaction to, and owner notification of, any major change in expenditures. The system should be responsive to changes in the schedule and to changes in scope of work. Reports should be issued not less than monthly.

Progress Payments

The CM should establish a system whereby the contractor is paid in a timely manner for acceptable work. The system should be consistent with the owner’s objectives and the contract requirements.

The system should identify to the contractor(s) the forms and supporting documents required, including proper contract cost breakdowns for pay purposes in order to facilitate rapid reconciliation of contractor’s applications for payment.

Construction Phase Reports

The CM should continue issuing the reports initiated during the procurement phase. These reports are:

- Schedule maintenance reports.
- Project cost summary reports.
- Cash flow projection reports.
- Construction schedule reports.
- Progress payment reports.

It is essential that communication be consistent. The above reports should be updated monthly and the CM should review pertinent information with the other project team members.

Project Summary by Exceptions

This is a narrative prepared for the owner’s review, pointing out impacts to the Project Management Plan and exceptions to that plan. The CM should monitor all facets of the project and communicate with the project team members concerning problems that occur during this phase to facilitate prompt action.

Special Record Keeping

The project management information system should specify a program of written documentation and accountability. When problems arise or are anticipated, the CM should increase the amount of detail and intensify efforts at documenting particular areas of concern.

In addition to the written daily reports, the CM should establish a program of photographic documentation that records job progress, documents conflicts or probable claims, and provides photographs for public relations. The extent of photography depends on the complexity of the project. Photographs should show existing site conditions such as mud, snow, ice, etc., and key elements of the work going in place. In the event of change orders or probable claims, it is essential to establish a photographic record as soon as the problem is recognized or suspected.

All photographs should be captioned and time dated.

Claims Processing

The CM receives all notices of claims by the contractor(s) against the owner for additional costs or time. The CM evaluates the claim contents, obtains factual information, reviews the impact, if any, of the alleged cause based on the current construction schedule, and make recommendations for the owner's consideration with respect to the contractor's claim. The CM may coordinate claims analysis and resolution efforts with other consultants and counsel engaged by the owner. At the owner's request, the CM may negotiate the claim of the contractor(s) on behalf of the owner pursuant to the owner's instructions. The CM may make final recommendations to the owner concerning settlement or other appropriate action. Careful documentation by the CM offers the owner protection against unjust or frivolous claims.

Each situation should be analyzed in light of pertinent contract clauses.

Record Drawings

Most owners require record drawings at the completion of the project. The CM should establish procedures for assembling and handling record drawings which are appropriate to the particular project. When the contractor(s) are required to provide a set of marked-up drawings, the CM will typically review these documents prior to the approval of any final payment application. At the end of the project, the CM should forward the contractor's marked-up drawings to the designer, who prepares a finished set of record documents for the owner.

When the CM has the responsibility for the preparation and completion of the record documents, the method to be used should be determined early and set out in the Construction Management Plan.

These drawings should show revisions in sizing and location of materials and equipment that vary substantially from the size and location shown on the plans and which are not documented by change orders.

Post-Construction Phase

Maintenance Manuals and Operating Procedures

During the course of the project, the contractor is required to submit maintenance manuals and procedures for operating equipment and systems installed in its work. Prior to final completion, the CM should coordinate the compilation, organization, and indexing of these materials and bind them into document sets.

Spare Parts and Warranties

The CM should coordinate all requirements for spare parts and warranties.

Final Permits

Regulatory agencies require permits to permanently utilize or operate a facility. Some agencies are more stringent than others and may require documentation, testing and statements concerning completeness of the project. Most require a final inspection. The CM should assure compliance with these requirements and assist in securing all permits.

Move-In/Start-up Activities

At the owner's request, the CM should assist in scheduling and coordinating for move-in or start-up and assist with training of the owner's personnel.

Final Payment

When the contractor has notified the CM and the CM has confirmed that all punch list items are complete, the CM should make recommendation, in writing to the owner, in connection with final payment to the contractor(s).

Contract Closeout

The CM should coordinate and expedite the completion of contractor submittal requirements prior to contract closeout, including the following:

- Certificate of substantial completion.
- Completion of punch list work.
- Final lien waivers.
- Guarantees/warranties.
- Final payment application.

The CM should work with the owner in final project cost accounting, providing project cost records and general project documentation as required and established at the outset of the project.

Contractor Call-Backs/Warranty Work

The CM may remain on-site after substantial completion for a period specified in the owner/CM agreement at the time of contract signing or as modified by subsequent agreement to assist the owner in resolving warranty issues.

It is not usually cost effective for the consultant CM to remain on-site until all warranty work is completed. Therefore, the CM should provide the owner with a list outlining responsibilities of each contract, or name and address of the company and name and telephone number of the contact person.

Close Out Reports

All significant reports that have been issued during the design and construction phases should be summarized in a final project history report. Cost accounting should be prepared with the final resolution of all expenditures. These reports should officially note the dates of substantial completion and commencement of warranties.

Chapter 7: Safety Management

Foreword

CMAA has long advocated a collaborative approach to safety management for construction projects and programs. In such a collaborative environment, *some* responsibility for safety is widely shared. All project participants, for example, have a duty to call attention to observed unsafe conditions as a key step in preventing injuries to themselves or others.

In addition to this basic ethical requirement, other responsibilities for job site safety derive from statutes, regulations, case law and contracts. Construction Management contracts should assign safety responsibilities consistent with the current status of the law, but do not always achieve this end. Because the legal obligations for safety must consider contractual obligations, regulatory compliance, and even criminal statutes, there is no simple answer to the question “what is the Construction Manager’s (CM) responsibility for project safety?”

The CM should be aware of these sources and types of responsibility. Based on this understanding, the CM should counsel the owner in creating contracts and processes so that:

- Responsibility for specific risks is assigned to the party most able to control and mitigate those risks, and
- A “safety culture” on the project makes it clear that all participants are expected to report known hazards to the appropriate individual or entity responsible for the involved work, as well as perform their own activities in full compliance with applicable laws and regulations, and
- Appropriate liability protection is provided to those parties responsible for monitoring construction activities on behalf of the owner.

Among other functions, the CM should be alert to possible inconsistencies or contradictions in the contracts between the owner and various other entities, and understand that laws and regulations may impose obligations in addition to or even in contravention of the contract terms.

The ‘baseline’ responsibilities of the CM related to safety are those spelled out by the CM contract and statute/law. The ‘baseline’ responsibilities differ sharply between CM-Agent and CM-at-Risk deriving largely from who is in control of the construction site. Typically the CM-at-Risk is in control of the site; CM-Agents are not. A typical CM-Agent agreement will generally require the CM to monitor the contractor’s activities as they relate to the contract documents and in some cases, the contractor’s submitted safety plan. Beyond the ‘baseline’ responsibilities, both CM-Agents and CMs-at-Risk may contract with the owner to provide additional safety related services such as the Safety

Management Services described herein. These may also include: project- or program-wide education to enhance awareness of safe practices and the ability of participants to recognize potential hazards; periodic monitoring and reporting related to safety conditions; other services as mutually agreed, but only if subparagraphs (a) and (c), above are strictly incorporated.

Introduction

This section focuses on the subject of providing safety management services to the owner if so required by the owner. Generally, the CM's obligation to provide services related to safety varies substantially from project to project and must be clearly specified in the contract between the owner and the CM. The CM should also review the contractor's agreement with the owner to ensure that there is no contract language specifying CM safety obligations or responsibility that is not clearly defined in the CM agreement.

The approach to safety management contained in this section is an example of a proactive approach; however it is important for the CM and owner to note that the approach described herein is an approach that is much more aggressive than that specified by the A-Series CMAA Standard Forms of Agreement. This proactive approach can be an appropriate method of providing comprehensive safety services to owners who are willing to provide the CM with the appropriate compensation, insurance coverage, and contract indemnification clauses. Prior to providing any safety management services, whether proactive or not, the CM should thoroughly review all legal implications of doing so and understand the risks associated with this service. It should also be noted that on some projects, indemnification clauses and insurance coverage for safety issues should be considered by the CM even if the services described in this section are not provided. As a minimum the CM must follow the safety policy and practices of his own organization

NOTE: The owner and the CM should also be aware of other safety management options which may be available. Depending on the owner's resources these options include:

In the instance when an owner has a well-established Safety Program/Organization, the owner can provide the Safety Coordinator to perform the noted project safety functions, and interface accordingly with the CM

If neither the owner nor the CM has an established Safety Program/Organization, with the resources to conduct the functions of the Safety Coordinator, a Safety Consultant may provide the functions of the Safety Coordinator and interface appropriately with the owner and the CM. Owner Controlled Insurance Programs (OCIP) usually includes more stringent safety controls. OCIP's are generally found on projects that have \$100 million dollars or more of construction value.

The CM must have a safety program in place for its employees in accordance with the local laws and regulations. This program should include as a minimum, education and training for the CM staff commensurate with company policy and the hazards expected to be encountered during the construction. The CM (company) is ultimately responsible for the safety of its employees.

Pre-Design Phase

Owner Commitment

The CM should discuss and thoroughly understand the owner's level of commitment for an overall safety program for construction work on the jobsite. The owner has the overall responsibility for

taking action should there be an issue regarding the nature of a hazard or safety responsibilities between the CM and contractor. If there is not a strong commitment to safety on the behalf of the owner, the CM may **not** want to take a contractual safety role on the project. The CM and owner should discuss the advantages and disadvantages for doing so as well as the current Occupational Safety and Health Administration (OSHA) requirements, expectations and established goals for the project. If a decision is made to have the CM implement and organize a safety program, the CM's contract with the owner must clearly define the scope of such services and include compensation to cover the CM's cost for appropriate liability protection. The prudent CM negotiates a separate fee for providing Safety Management Services. The added cost for acquiring additional insurance coverage should be included. The following information is provided based upon the assumption that the owner has requested and contracted with the CM to provide an overall Jobsite safety program

Initial Scope of Services for CM Providing an Overall Jobsite Safety Program

The CM should review the contractor's contract documents prior to procurement to ensure that there is adequate language to facilitate managing safety on the project. Project safety should be considered a process that is elevated above other issues and resolved in a timely manner. The CM needs to make it clear to the owner that anyone on the CM staff observing a safety hazard will bring the issue to the contractor for corrective action. Should the CM encounter an imminent danger situation, the CM must be empowered to suspend work on that activity immediately on behalf of the owner who will be ultimately responsible for the suspension. The CM's safety services scope can vary by contract from periodic observation and monitoring to more detailed monitoring, documenting, and reporting the contractor's safety progress.

Project Organization

An early member of the project team should be the CM's safety coordinator. The safety coordinator begins to develop input from a safety perspective, for such items as the Construction Management Plan, project procedures manuals, pre-construction drawings, constructability reviews, and the management information system.

Staffing Considerations

In order to coordinate and monitor contractor safety efforts effectively, a separate safety staff is created within the Construction Management team. The safety staff is comprised of safety professionals with project specific experience and knowledge of:

- Federal, state, county and local safety regulations
- Building Officials and Code Administrators (BOCA) and National Fire Protection Association (NFPA) codes\
- American National Standards Institute (ANSI) standards
- Occupational Safety and Health Administration (OSHA)
- Environmental Protection Agency (EPA); Distributed Energy Resource (DER) and other environmental regulations
- Hazard communications requirements
- Construction operations, specifications and drawings
- Labor relations

Some projects may require the expertise of a Certified Safety Professional (CSP), Construction Health and Safety Technician (CHST), and/or Certified Industrial Hygienist (CIH) due to special

conditions which may exist on the jobsite, e.g., asbestos or hazardous waste removal. It is important to convey to the owner the need to staff the project with experienced safety professionals. The staff must be of adequate size to cover the project efficiently and fulfill the agreed to contract scope.

Design Phase

The CM safety coordinator meets with the design team to achieve an understanding of the scope for the project. At this time the safety coordinator can be provided the opportunity to review drawings and discuss specific elements of the project to determine potential safety hazards, which may exist once the project is begun. “Design for construction safety” is a term that is used to consider safety during the design of a project. For example, window elevations, parapet wall heights, and construction sequencing can all help to prevent construction accidents.

The CM safety coordinator may then provide input for the construction contract documents concerning specific safety devices, equipment, and training that may be needed to mitigate the potential hazards. For example, certain roof designs may require special fall arresting devices and/or safety nets. It is to the benefit of all concerned if specialized equipment is required by the contract documents and not left to the discretion of the successful bidder. It should be made clear in the contract however, that it is the primary responsibility of the contractor performing the construction activity to perform its own review of the drawings to determine potential hazards. Any guidelines contained in the contract shall be considered a minimal requirement. The contractors are then required to devise systems or purchase necessary protective equipment at no additional cost to the owner. In addition, the contractor may be required to provide protective equipment to the owner’s inspection team.

Indemnification clauses and insurance requirements should be reviewed by legal for incorporation into the contractor’s contract documents. The intent is to protect the owner and CM.

Contract Requirements and Drafting Guidelines

The CM safety coordinator determines the items to be included in the construction contract documents concerning safety from the review conducted during the design phase. The contract documents should be structured to ensure the prime contractors and their subcontractors are responsible for safety. Each prime contractor should be required to submit, as per the contract documents, the following information for review by the CM:

- Written safety program
- Resume of safety representative
- Hazard communication program
- Specialized programs for specific job hazards
- Environmental waste disposal plan
- Drug and alcohol program (where required)
- Safety training programs
- Union safety regulations (where applicable)
- Site specific safety plan
- Task specific safety and health plans for high risk activities.

The contract documents should clearly state the contractor is solely responsible for the safety and welfare of his employees and for the protection of property and the general public. The contractor shall comply with all federal, state, local, and county safety regulations, applicable to his work site.

The prime contractor shall, through and with his safety representative, ensure that all of his subcontractors of any tier fully comply with the prime contractor's jobsite safety program. The safety representative shall be a full time employee of the contractor whose sole responsibility shall be for supervising compliance with applicable safety requirements on the work site and for developing and implementing safety training classes for all job personnel. The safety representative shall have stop work authority.

Subcontractors that have more than 25 employees on the site should be required to have a full time safety representative. The owner shall have the authority to request removal of the contractor's safety representative if that representative is judged to be improperly or inadequately performing his duties; however, that authority should not in any way affect the contractor's sole responsibility for performing the work safely, nor shall it impose any obligation upon the owner, the owner's CM, or any other party than the contractor, to ensure the contractor performs his work safely.

Written Safety Program

An essential element of the contractor's safety effort is the jobsite safety program. The contractor's safety program should contain all the necessary elements for the contractor to administer his program in accordance with his contract.

At a minimum, the contractor's written safety program should address the following:

- Compliance with laws, rules, and regulations, including any updates:
 - OSHA
 - Federal, state and local
 - Owner, CM, insurance carriers
 - 100% safety orientation of all jobsite personnel and visitors. (Verifiable tracking system – can be through visual sticker identification on hard hats)
- Duties and responsibilities of contractor's management personnel for safety
 - Project manager
 - General superintendent
 - Foreman
 - Safety manager/representative
 - Safety committee or team(s)
- Infractions of safety rules
 - Life threatening(imminent danger) situation corrected immediately
 - Serious hazards – would need to be defined in the contract
 - Reported to contractor's designated safety representative
 - Timely correction
 - Prime contractors to enforce safety requirements on their subcontractors
 - Non-complying employees to be removed from the project by the contractor or at the request of the owner/CM
- Housekeeping
 - Continuous cleaning required
 - Final clean-up required
 - Owner will perform if required and charge contractors

- Designated staging plan
- Means of Implementing Program - Proactive
 - CM representative attends weekly toolbox meetings with agenda recorded
 - Incorporate safety in weekly project meetings; ask questions to help the
- contractor plan safety into the work
 - Safety committee or safety walk around inspections with the contractor
 - Emergency procedures and phone numbers
 - Project bulletin board with required policies
 - Employees on each shift should have first aid/CPR training and maintain a current first aid/CPR card issued by an agency such as the American Red Cross
 - Completion of a job hazard analysis for each critical non-routine or high hazard construction activity and communication of this analysis to workers through pre-installation meetings for each new activity
 - Accessible safety program manual
 - Effective communication with a means of elevating safety issues to upper management for resolution
 - Tracking and record keeping procedures
- Accident Investigation
 - Investigate, document and report all accidents and near-misses
 - Develop steps to prevent a recurrence
 - Completion of all reporting paperwork
 - Proper notification and distribution

The contract documents should state the contractor's compliance with requirements for safety and/or CM's or owner's review of the contractor's safety program shall not relieve or decrease the liability of the contractor for safety.

No provision of the contract documents should act to make the owner, the CM or any other party than the contractor responsible for safety. The contractor should indemnify, defend and hold harmless the owner, CM, or other authorized representatives of the owner, from and against any and all actions, damages, fines, suits and losses arising from the contractor's failure to meet all safety requirements and provide a safe work site.

Safety as a Prequalification Criterion

The CM can assist the owner in considering contractors' safety records as a criterion for prequalification to bid on projects for that owner. This criterion should include contractor lost time frequency average, lost time severity average, OSHA 200 and 300 form information and the experience modification rate (interstate and/or state EMR) as determined by the state Worker's Compensation Board. This information can be helpful to screen bidders that may carry with them poor safety programs and may cause the owner increased Worker's Compensation cost. This is particularly important when the owner is providing a Wrap-Up Insurance Program (OCIP). The contractor must also provide an up-to-date list of all OSHA/state citations issued to them within the past three (3) years to include the disposition of each citation. The CM can find citation information on the OSHA website, www.osha.gov, under Establishment Search.

Procurement Phase

Pre-Bid Conference

The CM's safety representative and/or client safety representative can be provided the opportunity to address potential bidders at the Pre-Bid Conference. Safety requirements pertaining to the contract are highlighted at this time.

Construction Phase

Emergency Response Coordination

The CM safety representative should contact local authorities prior to bid to determine the availability of ambulance service, emergency response, police, and fire units.

Once the construction contract is awarded, the contractor's safety manager shall establish emergency response procedures, means and methods.

Safety Submittals

A review of the contractor's safety related submittals is conducted to determine if the requirements of the contract specifications have been met. The CM's review is not intended to be all encompassing nor to anticipate each jobsite condition the contractor may encounter. The contract provisions should indicate that no work can begin until the safety program is approved. For some projects/programs, it may be appropriate to allow a two stage safety program submittal: one covering the initial 90 days for mobilization, and the second covering the remainder of the contract. The contractor's submitted program is the central element for safety compliance by the contractor and his subcontractors. The contractors plan should include documentation of competent persons assigned to the project.

It is also important for the CM to develop his own safety program for Construction Management employees on the jobsite. Construction Management employees could be exposed to many of the same hazards, as contractor personnel. Therefore, it is good practice to provide and document training for the CM's personnel. The CM should at a minimum comply with the prime contractor's jobsite safety program.

Compliance Agencies

It is recommended that both the owner and CM develop lines of communication with agencies responsible for enforcing compliance of regulations applicable to construction of the project. The CM can encourage contractors that have been awarded work on the project to meet with these officials as well. A review of the project scope and contractual relationships between the owner, CM, and prime contractors is suggested prior to the start of construction activity.

Pre-Construction Conference

The CM's safety representative addresses all prime contractors at the pre-construction conference. At this time, information should be reviewed with the contractors concerning submittal requirements, emergency response programs and procedures, safety meeting times and schedules, training requirements, site safety surveys, accident investigations and reporting procedures. The contractor should be reminded to transmit all safety related materials to all subcontractors of any tier. The contractor's contract should have language to require the contractor to provide adequate

documentation for safety. The contractor should conduct additional meetings with subcontractors to review the information provided during the initial preconstruction meeting.

Contractor Safety Enforcement and Compliance

Each contractor shall appoint as stated in the contract, a safety representative to assist the contractor's management personnel in the implementation of the contractor's jobsite safety program. The safety representative and contractor's management personnel inspect on a daily basis their construction activity for compliance with established compliance criteria and document.

The CM monitors the contractor's daily construction activities and notifies the contractor in writing (with copies to the owner) of any deficiencies or imminent hazards or situations observed. The CM then follows up with the contractor to determine if corrective measures have been taken. The CM's actions in this regard are not intended to relieve the contractors of their responsibilities for safety on the jobsite.

Should the contractor fail to correct an unsafe condition, the CM immediately notifies the owner of the contractor's failure to correct the unsafe condition. The owner then notifies the contractor through the CM that the unsafe condition must be corrected or the work in question will be stopped until the condition is corrected to the satisfaction of the owner. Extensions of time or additional compensation are not granted the contractor as a result of any stop order so issued. Keep in mind that while an unsafe condition continues as a result of this sequence of communications, someone may be at risk

Safety Coordination Meetings

Prior to the performance of all critical, high hazard, or non-routine (as defined by the contract or contractor's submitted safety plan) construction activities, a job hazard analysis (JHA) shall be performed by the contractor. This job hazard analysis shall outline plans and procedures to be followed by the contractor in order to perform the work in a safe manner. A safety coordination meeting takes place between the CM, the contractor, and other affected contractors to discuss the job hazard analysis. At this time, the contractor thoroughly reviews the work in question and ensures safety guidelines are communicated to all concerned parties. The contractor is required to conduct training and hold meetings with the contractor employees using the JHA prior to conducting the work.

Safety Committee

The CM participates as a member of the jobsite safety committee. Other members of the committee can be comprised of the owner's safety manager, contractor's management, safety and labor representatives. The committee meets at least once a month to review safety issues and contractor progress on the jobsite. The agenda for the meetings should include:

- The results and recommendations of weekly committee walk-around inspections, or other safety inspections of the project
- A review of the contractor's safety/training activities
- A review and update of jobsite emergency procedures and access routes
- Coordination of hazard communication information for compliance with the federal hazard communication standard
- A review of accidents on-site and steps which were implemented to prevent a recurrence
- A look at anticipated construction activity to determine if safety coordination issues between contractors should take place

- A review of contractor accident rates in conjunction with National Standards

Safety Audits

The CM conducts periodic safety audits, if specified in the CM contract, in order to monitor contractor progress and compliance with the following:

- Orientation training
- Hazard communication training
- Accident investigations
- Jobsite inspection
- Emergency procedures
- Disciplinary action
- Safety meetings
- Overall administration of their safety program

It is recommended that the contractor participate in the CM audit at the time of the audit and be given the opportunity to take immediate corrective action if appropriate. A report of the audit is forwarded to the owner for his review and appropriate action. The purpose of the audit is to document observed areas where the contractor or his subcontractors are out of compliance with the contractor's jobsite and/or project safety program. The audit is not an all-inclusive listing of safety conditions on the project. In addition, the suggestions included in the safety audit are intended only to notify the contractor of observed instances in which it is not in compliance with its own safety program. The contractor is, by means of the safety audit, reminded of this obligation to comply with the safety program, including the regulations, laws, ordinances referred therein

Monthly Reports

The CM provides monthly reports to the owner containing the status of the program and of accident frequency and severity. Comparisons to national averages should be included

CM Safety Training

Construction Management employees should be initially trained and periodically refreshed in the identification and avoidance of hazards encountered on the construction site as per their jobsite safety program.

Chapter 8: Program Management

Introduction

This section discusses Program Management which, in the context of the construction industry, is the application of Construction Management to large, complex or multiple capital improvement projects. A Program Manager (PM) is generally assigned the responsibility of managing all of the resources and relationships necessary to achieve an owner's desired outcome. Depending on the owner's organization and needs, Program Management services may be provided by in-house personnel or contracted to a qualified consultant.

There are many similarities between project management and Program Management. Both utilize integrated systems and procedures such as budgeting, estimating, scheduling, procurement and inspection to manage the design and construction process. The principal differences between project management and Program Management are in the size, complexity and scope of the projects; the level of management and decision making; and the concurrency and magnitude of activity. (*See Chapter 2: Project Management.*)

Generally, a PM is employed to manage and coordinate a large capital program; potentially with multiple facilities in different locations. The PM may be asked to manage or contract for seemingly unrelated activities, which may range far from traditional design and construction activities. These activities may include assisting the owner in securing financing for the project, leading public relations and legislative initiatives, operating and maintaining the completed facility, and facilitating or purchasing a variety of products or services. The owner's needs and resources determine the scope of the PM's services. Owners with significant in-house expertise may not elect to contract for the full scope of a PM's services, but rather selectively choose services to supplement their own resources and expertise. Successful Program Management requires owner involvement and the integration of outsourced services into the owner's organization. Therefore, understanding interpersonal and organization integration is an important issue.

Program Management services are provided by a variety of professional consultants, such as Construction Managers, design-builders, designers, developers and others. The Construction Management profession developed and flourished as a result of the ever-increasing complexity of the construction process and the need to provide leadership in resolving the differences and coordinating the activities among owners, designers, contractors and other stakeholders. Construction Managers, by their training and experience, possess the knowledge, skills and abilities needed for effective Program Management. In many cases, Program Management may be considered an expansion of traditional Construction Management services, which is the context of this section.

Owners lacking the internal resources or expertise to perform Program Management may contract for these in an “agency” or “at risk” arrangement. In an “agency” arrangement, the PM is paid a fee to perform the services required by the owner, which may include managing the contracts between the owner and other professionals such as architects, engineers, Construction Managers and builders who are also contracted directly to the owner. In the agency arrangement, the PM acts as an advocate for the owner; however, the PM is not directly responsible for the performance of the other consultants and contractors. As such, the PM is not liable for problems caused by other team members and does not have a duty to the other team members unless stated in the PM’s contract with the owner.

In an “at risk” arrangement, the PM is directly responsible to deliver the project according to the requirements of the contract. The PM may perform the necessary services directly or hire sub consultants and subcontractors to assist. Ultimately, the PM is responsible to the owner for the quality, cost and schedule of all of the deliverables in the contract. Conflicting interests may exist between the owner and the PM as a result of this arrangement. The most delicate issue occurs when an owner converts a PM agency contract, in which the PM acts in the owner’s interests, to an “at risk” contract, in which the PM acts in its own interests. Although the intent can be clear, it is difficult for both parties to adjust their relationship. When using the “at risk” delivery method, the owner may want to consider hiring another consultant to provide agency PM to represent their interest.

Whether following the agency model or “at risk” model, it is imperative that the owner and the PM structure their contract to avoid or limit conflicts of interest and to avoid creating an adversarial relationship. Even so, the “at risk” arrangement is better suited to CM rather than the full portfolio of tasks typically performed under a PM contract. The primary detraction in using “at risk” PM is the difficulty in defining PM scope at the outset with sufficient accuracy, because Program Management activities are more often qualitative than quantitative and more often controlled by third parties. When working under a Guaranteed Maximum Price (GMP) and a fixed completion date arrangement, this situation can easily create unmanageable risk. This can lead to misunderstandings, disputes, and multiple changes that are more difficult to resolve than CM services in terms of cost and schedule. For example, how would an “at risk” PM schedule and budget “legislative funding support services” to secure project funding, while committing to a fixed completion date? In contrast, construction contracting activities are generally better suited to well defined cost and schedule control measures, so that CM “at risk” is preferable to PM “at risk” from the important aspects of scope definition and reasonable risk allocation.

Program Development Phase

Ideally, Program Management starts very early in the thought process that leads to a major capital improvement program. Typically, an owner must address an existing capital improvement need. The need may be an impending regulatory requirement, or perhaps a severe capacity restraint, which overpowers the organization's capabilities to manage the program or various phases of the program. By considering at the outset the organizational capabilities needed, many owners conclude that their ability to execute a major program is limited by lack of staff and, in some cases, the proper expertise that is necessary to define and manage the program on a sustained basis. Therefore, the owner will acquire the necessary expertise by contracting with an independent entity, a firm or firms that can provide the necessary staff and expertise to support the program.

There is clear value in combining in-house staff with outsourced resources. On one hand, the owner must have a trusted “smart, experienced and responsible” manager to consolidate and control the owner’s many program needs and to select, contract and manage the outsourced services. There can be in-house staff for continuous improvement, proprietary processes, core specialties, and for services that aren’t readily available on the market. On the other hand, the owner can benefit by outsourcing commodity services and products, resource leveling, and using “on call” arrangements for highly specialized talent that isn’t needed on a continuing basis and for high-paid talent that would upset internal pay scales. Finally, most owners can search out the best firms in the industry and learn from them as they work together. This approach gleans the best from both organizations, using outsourced support that will vary from part to full-time as the needs of the program dictate.

To enhance the opportunity for success, the PM's role should start early in the program definition phase. This includes an active role in defining objectives and concepts, and may extend to the acceptance and operation of the completed projects on behalf of the owner. Program Management ideally includes the early participation of the PM in developing and making the initial strategic, technical and business decisions that define and become the basis for the capital improvement program. The PM has the greatest opportunity for improving the chances for success during the program definition phase. As the program is being developed, a comprehensive Program Management Plan (PMP) is developed that then becomes the program's governance document.

In this early definition stage, the PM fosters an environment in which technical, legal and business professionals can collaborate to develop the PMP. If this collaboration is successful, the owner’s original concepts can evolve into a viable program that meets quality, scope, schedule and cost expectations. Working as an integral part of the owner’s implementation team, the PM guides the PMP process and presents the compiled document to the owner.

The Program Management Team

In this early stage, the Program Management core team is generally small. The team may be made up of planners, schedulers, conceptual estimators, financial experts, lawyers and other front-end experts as needed. These professionals may be available within the owner’s organization, the selected PM firm or within the various specialty firms that make up the Program Management team and may be introduced on a consulting basis to meet specific program needs. Supplementing the core team with part-time professionals helps to keep the core team small and efficient. A staff of administrators, technical professionals and managers normally support the program also. This staff is responsible for supporting the initial Program Management team for such tasks as information systems, logistics support, and production of the PMP.

The role and authority vested in the Program Management team by the owner should be agreed upon at the onset of the work. The owner may add additional roles and responsibilities to the PM's portfolio as the needs arise. An organization chart and task descriptions should be drafted and agreed upon together with the owner, along with a decision matrix showing how specific recommendations will be formulated and who will make final decisions. The majority of the time, Program Management works best as an integral part or extension of the owner's staff.

An essential component of the Program Management team that should be established during this early phase is the Project Controls team. The success of a program is measured as much on proper budget, schedule and document control as much as it is measured by the technical success of the

constructed facilities. Key personnel on this team include cost control engineers, schedulers, estimators, programmers and administrators who assist the PM in developing the overall scope, cost and schedule of the program. The project controls system is the backbone of the program. Early establishment of good project controls will enable managers to identify, assess and manage program trends effectively. This builds confidence in the PM team and will win support from the owner throughout the term of the program.

Program Management Plan (PMP)

One of the mainstays of Program Management is the written plan, or Program Management Plan (PMP); which is approved by the owner and defines the vision, implementation strategy, schedule and budget criteria, and the policies, procedures and standards for the program. It is a living document that must be updated periodically. The PMP is the master reference document for the Program Management team and provides guidance to the consultants engaged throughout the life of the program, from inception through planning, design and construction. The PMP provides a level of continuity and standardization across the program to facilitate time and cost effective communications and decision making. It serves as an organization's formal process for reviewing, evaluating, prioritizing, documenting, approving, implementing and maintaining all of its projects within the program.

Program Management Office (PMO)

As a result of best practices initiatives, certain agencies and owner organizations establish a Program Management Office (PMO) to oversee and implement all projects within the PMP (e.g., new construction, modernized facilities, information technology, and non-technical projects) The PMO concept is a management process that is seamlessly integrated and planned collaboratively. Within the PMO process, governance responsibilities and task ownership must be clear. A best practice PMO is one that has a strong charter which defines program success, typically in terms of quality work, safe work, work in scope, work on schedule, and work on budget. A strong charter coupled with a solid, well-structured PMP results in both successful scope and cost controls.

The PMO organization or team must be a well-coordinated, fully-integrated and high-performing group. This group should have the role and responsibility to oversee program delivery within five key functional areas:

- Understand the owner's needs and translate them into a capital program
 - Define and plan
 - Provide risk management and quality assurance
- Set project delivery strategy, define the project functions and select project teams to deliver them
 - Set up the program's infrastructure, processes and management office
 - Coordinate and establish standards for implementation
 - Support program processes and procedures (as outlined in the PMP)
 - Implement strategies
- Control program execution through budgets and schedules, procedures, documentation and communication
 - Provide project management and support
 - Coordinate the overall team
 - Establish and enforce technical standards
 - Provide project planning, budgeting, scheduling and document control

- Provide status reporting
- Effectively close out the program
- Collect and institutionalize best practices and lessons learned
 - Identify and incorporate continuous best practices

Best practice organizations also invest in project management skills training for staff in order to achieve consistency in project delivery and to reduce project failures. Best practice organizations also have an executive group that has the overall management responsibility of monitoring performance measurement systems.

Metrics are used to track program performance (scope, budget, and schedule) in real time. PMO organizations implement a review process using these key performance measures. Best practice organizations link and align their performance measurement systems (scorecards) with long-range goals and strategic objectives. These organizations also value and measure individual input in the form of satisfaction surveys to key stakeholders (e.g. user groups, consultants, and contractors). Best practice organizations are continually improving their Program Management methodologies.

Management Information Systems (MIS)

Large capital improvement programs often present the team with an opportunity to supplement, improve or replace the owner's management information systems. The owner's systems may not be adequate or appropriate to accommodate the additional volume of data and documentation that results from the major program. The management information system should be based on the specific criteria formulated by the PM to control and report on the progress of the program. Computer systems, both hardware and software, must be chosen early in the process and established as a standard throughout the program. This will allow continuity of information and reporting as the program expands.

One of the challenges of long duration programs is that they introduce a software upgrade risk. With programs that can carry through 10 or more years, software upgrades are inevitable and must be managed. Conversion to new software systems and even upgrades of the original software can be problematic. It is important to consider the stability of the software providers, including their record of support, when selecting software systems. As software vendors promote their "new and improved" upgrades, conventional wisdom for PM's is to avoid the cutting edge. There is too much at risk with major programs to serve as the beta group for software that lacks an industry track record.

Reporting of progress, schedule, costs, scope changes and quality compliance must be achieved in a standard electronic format available to every entity engaged in the program. In addition, the flow of documentation must be established and an early decision must be made to capture, archive, and distribute documents in an electronic or manual mode. Electronic document control for large capital improvement programs can be cost effective and provides many side benefits that are essential to large capital programs. The PM must determine the right level of data sharing and integration of systems that is practical.

Scope Definition

Concurrent with the establishment of the management information support systems is the requirement to establish detailed procedures that control the administration, accounting and

management of the program. The primary focus at the earliest stage is to validate the need for the program and determine its fiscal viability. It is essential that the PM provide reasonable cost estimates based on realistic schedules, the full scope of work and the agreed level of quality. At this stage the PM must anticipate potential delays and factor appropriate contingencies into the program. The PM must identify the scope of as many related requirements as can reasonably be identified. These may include environmental studies, sustainability, wetland preservation, archaeological investigations, historical preservation and entitlement considerations; among other activities leading to the final permits. Each will have an impact on the cost and schedule of the program. Once the program has been quantified and agreed upon together with the owner, the next step is to develop the program in terms of schedule, cost, quality and scope.

One of the most difficult areas to reduce to writing is the level of quality. It must be understood that the level of quality impacts all areas, but most importantly the final cost of the improvements. Quality may also have a dramatic impact on the length of time required to design and construct the program. The PM, with the support of the planners and designers, must establish the quality standards that will be met by each consultant and contractor. This may result in a set of simple program quality guidelines or a detailed manual of quality standards.

A final scope of work is drafted for approval by the owner. It is based on detailed working sessions with the owner as well as other stakeholders. A realistic budget and schedule are then established for final approval including cost escalations, market conditions, risk assessment and appropriate design and contingencies. Formal approval is usually reserved for a board of directors or similar entity with the appropriate fiscal responsibility.

The owner may request a study of various strategies to improve program cost or schedule including various delivery methods. In addition, the PM may examine a strategy for dividing the program into manageable segments or projects. This process may go through numerous cycles before the ideal solution is found. The execution strategy, once approved by the owner, is fully documented by the PM and included in the PMP along with the resulting budget, overall scope of work, quality standards, program schedule, and the major milestones that are critical to the successful implementation of the program.

Design Phase

The PM's role is to manage a program of multiple projects or a large project with multiple elements. During the design phase, the PM is focused on the overall program design aspects and how they interrelate, rather than on the individual design of various projects. However, it is the smaller individual projects comprising the program that must all come together to deliver a complete and functional finished product. The PM is responsible for directing the production of designs to meet the objectives within the context of the program constraints. The PM is also responsible for integrating all of the program elements and the individual projects. All of the elements of Program Management – including cost management and time management – are required during the design phase. The PM's role is to manage the scope, schedule and budget of the overall program. Impacts such as design delays, cost overruns, and environmental issues, on a single design can have implications for the entire program.

Design Organization Structure

The PM must establish the organizational structure so that the required resources are available to

complete designs for individual projects within the required schedule, budget and quality standards. This structure also needs to facilitate integration of the program elements and communication within the Program Management team. Structuring the design organization, which will probably include several design teams, may include consideration of client/owner policies such as inclusion of disadvantaged, local and/or small businesses. The structure needs to be sufficiently flexible to provide a balanced pool of resources during periods of uneven workload.

The PM also assists the owner in selection of the design team. In addition to establishing a scope of services for each of the projects, the PM should standardize the process by assisting the owner in developing a “standard” contract form for scope of services or by utilizing industry standards contracts, such as the CMAA series.

Design Criteria

The PM oversees the development of the design criteria, a crucial factor in successful implementation of a large program. Good design criteria are needed to promote design consistency and maximize design efficiency. Such efforts will assist in controlling construction costs, expediting procurement, and improving ease of maintenance by assuring consistency among projects in the program.

The design criteria should address a number of issues. These include space and functionality, codes and standards, operation and maintenance requirements, safety and security, and local market conditions such as availability of materials.

Communication during this phase is critical. The PM involves all relevant parties in the development of the design criteria. The owner, the user, and the regulatory agencies contribute to the development of the criteria. Design standards should be communicated to all appropriate project team members, so that they understand the expected level of quality. Programs of projects have been shown to benefit from standardization of designs for systems and project elements wherever possible, as this can reduce design, construction, and operations and maintenance costs, and also reduce construction time. The more standardized the process, the more efficient the design process will be from one team to the next. PMs have an opportunity that project managers don’t have. They can examine their individual projects to find similarities. When there is a similarity, they can rotate the similarity from the project workflow to the program. Then there is an opportunity for repetition instead of reinvention on every new project. Most important, they can improve across multiple projects. The results can produce enormous benefits in time, cost and quality.

“Rotation” describes the process of turning a custom, project-oriented activity into a continuous, program-oriented standard. Standard processes, standard products and standard human participation save time and money. But standards shouldn’t be static; they should be a platform for continuous improvement. People do better work as they gain experience. They improve their processes, their work products and the buildings, and the people themselves get better. The amount of rotation, repetition and refinement that can be achieved in a program is a function of the number of projects, the similarity of the projects and the authority of the PM to enforce standards and push improvement. The 3 Rs require analyzing projects in a program to identify the similarities, choosing the similarities that are the most repetitious and offer the greatest possibilities for standardization and continuous improvement, and focusing on ways to improve these standards at the program level.

The PM should provide typical or similar documents to the team members for use as examples to reinforce the expectations of the final design deliverable. At this stage, the PM is concerned with delivering a design that meets the owner's criteria and applying a realistic construction methodology consistently across the overall design program. This typically will include identifying the code requirements and refining quality standards of the finished product. Additionally, the PM will need to identify and address regulatory requirements. These may include the environmental, wetlands, local permitting, and other necessary regulatory requirements that can impede the successful delivery of the program if not addressed early in the process.

Design Development

Design development in large programs involves projects which might be designed simultaneously, in overlapping sequence, or in series. The PM must focus on the overall design program so that the various designers adhere to schedule and deliver coordinated work products. The PM must monitor design contract costs as well as construction budget estimates for consistency with overall program budgets. The PM must establish a comprehensive design review process; and advise the owner of any deviation from approved program standards of performance. The PM must promote designs with an eye toward constructability, initial capital costs, and life-cycle costing including operation and maintenance.

The PM should seek to improve the individual designs, drawing on lessons learned from early projects through construction requests for information, bids, and shared experience within the program. The PM should also seek opportunities for cost and time savings through value engineering and applicable peer reviews.

Building Information Modeling brings the previously separate functions of planning, design, construction, commissioning and maintenance/management together as an integrated whole. With the increased emphasis on life-cycle cost of construction, the PM may work with the owner to establish criteria for all phases of the program to optimize the flow of information among all the participants in the program.

The PM facilitates constructability reviews for project designs. The PM also reviews construction estimates prepared by the designers and prepares independent check estimates so that the project is within budget.

Construction Contract Packaging

The PM will often assist the owner with shaping the overall design program into executable contract packages that meet the owner's scheduling and operational needs. In this effort, the PM will focus on the integration of the overall design program and how the various design packages will be scoped, designed, phased, and scheduled to comply with the owner's goals. This can be particularly challenging when construction of a large program must fit within the owner's current envelope of on-going operations.

The PM should be instrumental in the construction contract development, utilizing either industry standard contracts, such as the CMAA series, or assisting the owner in developing a customized construction contract that meets the program needs. Depending on those needs, the PM may also provide recommendations and assistance with alternative construction delivery methods.

Quality Management

A critical component of the design review process is consistency. The designer needs to understand clearly the standards and expectations against which the design will be evaluated, and this needs to be consistent from beginning to end. The same review team should be involved at each stage of the design process whenever practical. This provides for consistency and efficiency, resulting in better value to the owner and better quality for the project.

The PM reviews designs to verify consistency with design criteria, regulatory requirements and constructability considerations. The PM also monitors the design team's compliance with the program's quality management plan and document control plan. Steps to enhance design quality may include peer reviews of designs and periodic audits of the design manager's records.

Cost Management

The PM's responsibilities for cost management during design include management of design costs, the estimated costs of facilities under design, and the overall program costs. Management of program costs during design involves a disciplined application of the program's procedures and processes for allocation of project and program contingencies. The PM should maintain up-to-date local market construction cost information and pricing indices to ensure the accuracy of construction cost estimates and budgets. The PM controls costs during design by balancing design resources and by promoting design efficiencies such as standardization of systems in general use within multiple projects.

The PM also manages program costs through construction contract packaging. The PM can add value by monitoring market conditions, conducting contractor outreach workshops, and adjusting contract packaging and the timing of bid advertisements to attract more competition. Large programs can often affect local construction markets and seasonal conditions may need to be accounted for in some regions.

At times program costs may be affected by the need for interim facilities ("swing space") for entities displaced by project construction. The PM can minimize these costs by requiring designers to allow for construction phasing. Cost management by the PM may also include management of cash flow within the program budget, depending on revenue from bond sales, tax levies or other financing mechanisms.

Cost management is fundamentally different in Program Management than in a single project. The classic view of cost control is that one makes estimates, establishes a budget, estimates design as it progresses, works diligently to prevent scope creep and hits the budget at the end of the job. In addition to a greater opportunity for owners to change their requirements, variability and uncertainty of pricing are potentially more of a problem in a program as opposed to a project.

Since no one can control those price events, the PM needs to have adjustment mechanisms. Budgeting and estimating are predictions of future costs and are rational processes, but bidding can be irrational and unpredictable. The project budgets are based on estimates of construction cost. These budgets will likely anticipate inflation and each project budget will likely include a contingency to cover the unknown and provide some ability to react to surprises. PMs are savvy enough to know that unpredictability is predictable. Eventually, on every program there will be a budget bust, the potential for grievous embarrassment and a big problem to solve.

If the program is viewed as a series of independent projects, each with its own contingency, then it is highly likely that the program will exceed the original budget. Here is what will happen:

As the program unfolds and time passes, there will be cost swings, above and below a core inflation rate, driven by temporary market conditions. So, in a program with many projects, there's a tendency for price valleys to get filled with scope increases, and the peaks are climbed with embarrassing supplemental appropriations. The inevitable price fluctuations cause inevitable program overruns. The remedy is to view the program budget as a whole and to manage valleys by shunting the values they create into program contingency.

Time Management

The PM must formulate the program schedule that addresses contract phasing with appropriate regard for controlling activities among multiple contracts. This process will create a critical path that will move among various contracts through the life of the program. A useful strategy is to generate interface plans that describe and detail the areas of overlap as well as the coordination issues among contractors. Interface plans become particularly valuable when the program includes phased access release areas that one contractor gains from another while both are actively under way. A line on a plan that delineates one contractor's work area from another's is invaluable in providing clarity. By carefully depicting the space and time of interface points, the PM can mitigate a major source of dispute and delay. Once the program schedule is set, the PM should track progress against it and encourage the team to look further and further ahead to identify variances in the making. By identifying schedule departures in advance, the Program Management team has time to develop work-around plans and implement mitigation measures before the issues impact progress.

Information Management

Communication at all levels within the program team is critical. The PM needs to communicate constantly on issues related to design, costs, schedule, and other program concerns. The PM is responsible for establishing an environment that facilitates and encourages designers, sub-consultants and affected parties to communicate regularly and effectively. Communication and information management tools include use of check lists to track progress of the project teams; meeting minutes, action items lists, and records of telephone calls; and a system for disseminating the information to the project team to keep everyone informed and on task.

Web-based project management systems are becoming the standard tool for managing information for large programs. Web-based systems allow large and geographically dispersed teams to be in constant communication, and for such communication to be documented. System characteristics vary, but generally include document control, communication tools, a calendar, and review and approval functions.

Procurement

Procurement Scope

The procurement function can extend from inception through final acceptance by the owner/operator. It can include multiple phases and functions, such as up-front professional services to develop a business plan or implementation plan, A/E design services to develop a concept and provide detailed design documents, CM services to provide constructability reviews and to manage the construction phase, CM at risk/or general contractor that will build the facility, and start up and commissioning specialist services that can work with the owner/operator to accept and operate the

facility. Typically procurement includes advertising, the request for proposals or bids, pre-proposal/pre-bid meetings, addenda, receipt of proposals/bids, bid review, and contract award.

The PM's procurement responsibility can start, however, before there is a definition of scope and/or services to be procured. PMs can advise owners as to funding, permitting, contract packaging, phasing, interdependencies, design standards, and the management organization as well as contract strategy and contract methodology. For example, the Program Manager would review the advantages and risks of procuring owner furnished equipment and long lead items.

Procurement Strategy

As part of the PMP, a procurement strategy would be articulated and based on identified projects, scope of work documentation, order of magnitude budgets and program phasing. The owner may have established procurement procedures or they might be developed and implemented through the program organization. The PM must evaluate the relationships and interfaces among the projects (such as physical, operational, and type of work) over time to gain a thorough understanding. Based on this understanding the PM would recommend a strategy for how to package (number of contracts) and deliver (e.g. design build, traditional design bid build, and fast track). Deciding what contract packages and type of delivery are most time and cost effective to the owner is one step that many PMs miss or spend too little time on. It is an important step because the number of contracts and the delivery method not only affect owner risk, but they also drive the extent of planning, design and construction contract soft costs - the management costs necessary to implement the program.

PM Role in Procurement

The owner can use its organization, a PM or a combination of resources to provide procurement services.

As services are defined based on scope, the PM can recommend what scope and services need further clarification through planning, what can move to conceptual and detailed design and what and how construction will be managed. The PM can also assist the owner by developing scope and procurement documentation for proposal or bidding purposes including estimates, design standards and schedules.

As projects move through their various phases, the PM should revisit with the owner the earlier decisions relative to packaging, delivery strategy and the procurement plan. Of course, the PM is responsible for expediting or facilitating the process to meet the program goals. The owner can charge the PM, for example, with the additional responsibility in the procurement phase of integrating and distributing all qualification or solicitation documentation, to include Requests for Qualifications or Requests for Proposals, contract drawings, project specifications and addenda. The timely issuance of addenda is important. Addenda issued too close to the bid due date may result in poor bid results or cause a postponement of the bid date. Once the bids are received, the PM must assist the owner in expediting the award process. This includes working with the designer or contractor in its submission of the bond and insurance information and working with the owner to expedite review, contract award and issuance of notice to proceed. Any issue that impacts a given project has the potential to impact the ultimate outcome of the program of which it is a part.

As projects are further defined in the design phase, the PM directly or through the Construction Manager must review again those things that typically impact a project. Some examples include delays, cost growth, poor quality, market conditions, the dynamics of change, technology and

regulatory impacts. A second or third look will likely precipitate further due diligence and adjustments to previous assumptions.

The PM must advise the owner as to the sequence of the projects that make up the program. Availability of funding, interdependencies among projects, contract packaging, and phasing are all factors which enter into overall decision making and scheduling.

Procurement strategies also have budget implications. Some procurement strategies that should be discussed and agreed upon when formulating the preliminary project budget include the following:

- Pre-Design and/or Pre-Construction Support Services
- Design-bid-build, CM-at-risk or design-build project delivery methods
- Owner furnished equipment or materials and long lead items
- Contract Pricing Strategies
 - Firm fixed price or lump sum contracts
 - Cost reimbursement contracts
 - Unit price contracts
- Property Acquisition Strategy
- Utility Relocation Strategy

Any or all of these are issues to consider when developing potential procurement strategies, depending on the nature of the program as well as the legal and financial requirements. All of these issues will have budget implications that the PM must take into account when arriving at the initial construction and program budgets.

Market Analysis/Bid Opportunity Communications

In addition, the PM can provide detailed market analysis of the potential construction bidding climate. This can be accomplished by determining the availability of labor, equipment and material resources on a global basis. The PM can also tailor this information to meet specific owner requirements such as minority business enterprise (MBE) participation. In some cases the PM may conduct industry outreach to attract proposers/bidders. This could involve publicizing the magnitude of large programs by developing tailored presentations to the design and construction industry and the media in an effort to highlight the program and market the potential commercial opportunities. These preliminary orientation forums are excellent tools for informing the industry and helping to encourage greater competition.

Schedule and Document Management

In the procurement phase, the PM also recommends program schedule and other time-related specifications that are appropriate for the specific project and the overall program, consistent with the size and complexity of the work. This can provide a level of understanding and build confidence with the owner and contractors. From a program perspective it is important that the PM identify the interfacing milestones and provide the appropriate coordination language to address schedule overlap and to mitigate schedule impacts as a result of delays to project interfaces. The necessity for clear, concise, unambiguous scheduling specifications cannot be overemphasized.

In addition, the PM can typically schedule the necessary pre-proposal/bid meetings with designers/contractors, coordinate project site investigations, if applicable, and review the project's master schedule, pre-bid schedule and scheduling requirements with potential bidders. During this

process, it is important for the PM to engage a dialogue with potential bidders, seeking their commitment, input and response to the time management and scheduling requirements consistent with the owner's procurement regulations.

In certain public agency organizations, communications with potential proposers/bidders may not be allowed because of the potential for or perception of a conflict of interest. Commitment to making the program schedule work is the responsibility of all the project players but it is the PM that develops and orchestrates the process. Key to this success is the ability of the PM to develop an agreement or understanding among team members on the relevant time elements of their projects and scheduling requirements and how they support the program schedule. The PM integrates project elements into the program so that it meets identified future needs, while proactively making adjustments to meet the owner's ultimate goals.

Construction Phase

The PM's objective during construction is to expedite and enhance the efficiency of the construction process through planning, organizing, providing structure, communicating openly and facilitating the process while focusing on fulfilling the owner's scope, cost, quality and time requirements for the entire program. This is best achieved by adopting a commitment to create an environment in which contractors can be productive. The operative characteristics are clarity, flexibility, speed, and efficient program processes. To that end, the PM typically performs the following functions.

Provision of On-Site Facilities

When requested as part of PM services, the PM can plan the logistical support required to effectively manage the construction. This can occur early in the planning process. Based on the scope and contract packaging assumptions, the PM can develop plans for centralized and/or common office and site facilities for use by all entities engaged in the program. The PM can prepare an order of magnitude assessment of resources based on the scope. By quantifying the total resources on the program schedule the PM can analyze and determine the peak demand for facilities as well as the pace of staff mobilization. This provides the opportunity to optimize the phased expansion and contraction of the program facilities to match demand.

Coordination and Communication

The PM provides coordination and leadership to the planners, designers, Construction Managers, contractors and other entities involved in meeting the program requirements. One of the PM's challenges is to understand the roles and responsibilities within the owner's organization and program team and to determine what information needs to be communicated to whom and when. If all communications with the consultants and contractors are either through or with the prior knowledge any one person or organization, then there is either a delay in decision making or the program becomes overly reliant on the judgment and communications of one entity. However, if there isn't a certain amount of structure to formal communications, then there is loss of quality, at best, and chaos, at worst, with no one in charge and no one accountable. The real challenge for the PM is to foster a work environment of open communication with the right procedure and documentation at the right level. The PM must establish this balance with procedures and reporting requirements so that communications flow with continuity and organization across the program. Most experienced professionals recognize the need for the right communications and know what communications are required and when the PM must personally send them. On this point, it is valuable to staff the project with professionals who have the judgment to recognize when to route

communications through the PM and when to move ahead without PM review for the sake of efficiency.

The PM continually monitors the program by measuring progress of each project, identifying the key interfacing milestones among projects and their impact on the program, and by facilitating actions of all the stakeholders to accommodate individual project needs while avoiding impacts to the program as a whole. The goal is to maximize the efficiency of the program from planning through construction.

Program Progress Meetings

The PM conducts periodic program progress meetings and provides periodic performance reports to the owner. These meetings are conducted with representatives of the various projects. The PM will follow established owner protocols or recommend new protocols and procedures as appropriate. Where owner protocols do not exist, the PM establishes the reporting criteria, format and performance metrics such as a critical path schedule, manpower, cash flow curves, work placement rates and cost compared to budget reports. The PM may monitor program performance by chairing or facilitating these project review meetings, which may cover safety, quality, schedule, cost, and operational issues. These meetings and the information presented provide the basis for decision making and coordination among the various stakeholders. Typically program meetings are scheduled once a month; with smaller individual meetings held more frequently or as needed.

Time Management

The PM establishes procedures for planning and monitoring compliance with the program time line as developed by the program schedule, which is also commonly referred to as the master program schedule and the integrated program schedule. The PM establishes the overall phasing of the program and contract packaging. After defining the logic, sequencing and interfacing milestones, the PM develops the program schedule, overall durations for the projects, and the critical path of the program. The PM then incorporates these time elements into the various contract documents, including program float based on the risk assessment of potential time impacts. During the construction phase, the PM will incorporate the contractors' CPM schedule updates into the program schedule. Project activities may be adjusted in order to maintain the most efficient and effective program schedule considering an optimum balance of time, cost, safety and quality goals. The individual contractor baseline schedules form the basis for evaluating and resolving time-related contract claims. The program schedule is the best tool for making program level decisions when there are schedule conflicts between or among projects.

Budget and Cost Monitoring

The PM develops the program budget based on the initial scope definition, phasing and packaging. The PM records, projects and monitors program costs throughout the program from planning to construction. As project contracts are awarded, the project line item estimates are replaced with the actual committed amounts, plus allowances for unknowns or contingencies.

As scopes are defined and as costs become more definitive, the program budget is updated to reflect the latest cost to budget comparisons. Once actual cost growth trends can be measured, then the PM can utilize this data to recommend decisions in managing the overall program budget. The objective is to manage the incurred costs, estimated costs, and costs to complete in order to stay within the program budget.

Funding/Cash Flow

The PM forecasts cash flows, not only based on the initial budget assessments, but continually throughout the life of the program as costs are defined and forecasted. Using time and cost management techniques, the PM will keep the owner informed of cash needs for the development of the program financial plan, for bond issues and for normal contract payments. The PM through the CM monitors the payment procedure for processing payments to the contractors and conformance to contract requirements.

Requests for Information

It is common in the industry for contractors to pose questions using a formal document called a Request for Information (“RFI”). This is a standard project management tool. What distinguishes this process for programs is that the PM must establish more formal control and provide group access to the information to facilitate open communication and speed to resolution. The PM typically uses an electronic RFI process in which the contractor, PM and designer can all view each RFI via a program server or a secure internet website. Each RFI is numbered and the time to resolution is recorded in an RFI log. Most programs strive for a one week response time for RFI’s.

Other variations to the traditional project management RFI process that tend to be distinctive of programs are the request for change (“RFC”) and the request for explanation (“RFE”). Often, contractors will pose change requests using the RFI tool. Because change requests take longer to review and resolve, it is important for the PM to consider establishing an RFC process, similar to the RFI process, with a longer review period for RFC’s. A less commonly used tool is the RFE. The RFE is the opposite of an RFI. A RFE is initiated by the owner or PM and is posed to the contractor. For example, the owner or PM may issue a RFE if the contractor were failing to prosecute critical path work items. Because the RFE has seen limited use in the industry to date, there is not a generally accepted duration for contractors to respond to RFE’s. A suggested approach is to allow the contractor the same time to respond to a RFE as the designer has to respond to a RFI.

Change Orders

The PM works with the owner to establish the change order procedure and reports and monitors the change order process for all contracts. Refer to Section 3.0, Cost Management, for a detailed discussion on this subject. Whether the change is to a design contract or construction contract the authorization, notice and direction to the designer/contractor must be documented and the process managed in a time and cost effective manner. The PM must render sound advice to the owner so that decisions relative to change can be handled effectively.

Claims Management

The PM, and/or Construction Manager, as applicable and per the owner’s protocol, establishes methods and procedures to minimize the potential impact of claims through prompt, equitable, and consistent resolution strategies for notices of intent to claim. The objective is to address contract changes with minimal disruption to the on-going program construction effort. The PM monitors the claims management process. Resolving claims on one project may have a direct impact on other projects and the PM must make recommendations that will minimize the overall impact on the program. This sometimes means that individual contractors suffer greater impacts as part of a program than they would otherwise experience for the same event in a stand-alone contract. The program procedures and construction contract documents should address the management of claims

including merit evaluations, entitlement evaluation, negotiations and settlement procedures, handling of disputes, and appeal procedures.

Quality Management

The PM and the owner establish the quality standards for the program, and, in conjunction with the CM, the procedures for meeting contract requirements. Quality procedures typically delineate responsibilities for quality control (“QC”) and for quality assurance (“QA”). QC is defined as the operational techniques and activities that are used to fulfill requirements for quality. QA is defined as all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality. The PM monitors and provides oversight during the design process and works with the CM to assure quality during the construction process. Whether the owner chooses to perform quality control directly or whether they choose to only provide QA of the designer’s or contractor’s quality programs, the PM usually implements and establishes a method of measurement to achieve the quality requirements of the program.

The PM must assure that all projects are adequately managed so as to achieve the same quality standards set for the program. QC and QA responsibilities must be clearly defined in the design and construction documents. The PM, working in conjunction with the CM, monitors the performance of the Construction Management team's inspection and testing for QC and QA so that all projects are consistently inspected to the quality standards established for the program.

Owner-Purchased Materials and Equipment

The PM investigates the potential benefits of the owner directly purchasing materials and equipment for the program and makes recommendations to the owner. Upon concurrence by the owner, the PM works with the designer to develop appropriate contract documents for procurement. The PM monitors the procurement of owner furnished materials and equipment to assure that the needs of projects are met in terms of schedule and construction coordination.

Record Drawings

Record drawings are contract documents that incorporate important final changes and variations that are not shown in the plans, based upon what was actually built. Changes are continually recorded on record drawings during the project life, so that a final set of record drawings is available at project completion. The PM monitors the process of furnishing record drawings to the owner. Working with the owner, a system is established for receiving, storing and referencing record drawings. The actual day-to-day updates to record drawings may be the Construction Manager's responsibility, but the PM must establish the standard requirements and establish continuity across the program.

Document Control

The PM, working with the owner, establishes procedures for document control, record keeping and file retention. The PM also defines document control procedures for continuity and consistency among all projects. The PM may also establish and implement the management system necessary to receive, record, track, distribute and file all documentation. The ability to manage the flow of documentation effectively is absolutely critical to program communications and decision making. The procedures for identifying and duplicating, and the method of handling and storing records are established early in the program. During the construction phase, the PM works with the CM to assure the adequacy of the document control process.

Management Reporting

The PM monitors the reporting system that was established early in the program. The system would facilitate creation and production of Construction Management reports. The value of the reports hinges in large part on the freshness of the data. Ideally, the reports would reflect the status of the program in real time. An acceptable approach would be to create a reporting system that captures the progress of every contract every week. This is feasible, even for multi-billion dollar programs. The Construction Management section of the program report summarizes status and issues of scope, cost, quality, safety and schedule for all of the projects within the program. The PM monitors the type, format, frequency, and distribution of the report for the owner.

Post Construction Phase

Program Completion

Completing a program requires procedures to close out all program contractual and administrative activities. After substantial completion of a program segment or individual project, the PM monitors the close-out of each project and verifies completion through the individual Construction Manager for that project. Close out items would include completion of all construction contract punch lists and issuance of substantial completion; settlement of all changes and claims; submittal to the owner of required documents such as warranties, operation and maintenance manuals, and record drawings; acceptable disposition of spare parts; confirmation that permit, right-of-way requirements and training are complete; confirmation that grant or funding provisions are satisfied; receipt of signed releases from the contractors; issuance of final payment; and demobilization of contractor facilities.

Program Projects Interface

The PM coordinates the completion and turnover of individual projects and monitors the remaining interfaces with the other projects still under construction within the program. These interfaces with the active projects are often critical. Where facilities are needed before other projects are complete and temporary infrastructure is needed, the PM must identify the temporary infrastructure scope and cost, and incorporate the work into the program to allow full activation of the facilities being turned over. Phasing of projects is another Program Management function that promotes the efficient use of completed projects and or parts of projects to maximize the owner's return on investment.

Maintenance Management

Operations and maintenance ("O&M") management support is a natural extension of the activation process and is based on advance planning that should take place at the start of the planning process and include adequate staffing and resources. It may also include training of staff. The PM can assist the owner in the process of maintenance management of a new program. The PM can assess the maintenance needs of the projects, and design a maintenance management system to address these needs. The issues of maintenance effort, schedule, materials required, and spare parts inventory may be included in the PMs responsibilities. Typically, the PM is responsible so that the O&M manuals, as-built drawings, and spare parts lists are in accordance with the owner's current O&M management system. The PM may utilize Geographic Information Systems, Global Positioning Systems and Building Information Management Systems to provide effective O&M support.

Activation

Program activation, or startup, is the process of transitioning from construction to permanent operation of a facility and the owner or owner's staff become prepared to accept and operate a new

facility or facilities. In this phase, the PM assists the owner in managing the activation function by providing support to define staff planning, service contract requirements, facility requirements that are not provided through the construction contract, operational planning, and operational assessments. The goal is to obtain maximum utilization of the activated facility at the least cost in parallel with the design and construction process, and integrate the facility into the production and operations plans and schedules. On major programs, the activation process may be a sequential process of bringing on-line various facilities or components of a given facility and testing those facilities or components under real conditions before acceptance for permanent operations. The PM may support the owner by developing staff plans based on the transition of ownership and a schedule to mobilize the owner's advance staff. The PM may also support the owner in developing and administering procedures for warranty administration to assure that defective work is remedied in a timely manner. Activation should have high visibility throughout program development and execution. The progress and issues should be reported periodically directly to the owner. Issues requiring management decisions and additional resources are best presented in a formal reporting system.

Facility Management

In large and complex programs, the operation, maintenance and funding commitments are often key to meeting the program objectives. For example, Build, Operate, and Transfer (BOT) programs often have a significant operational period with specific maintenance and repair obligations and expansion milestones based on agreed demand. The PM may be retained through the operational period to oversee and monitor program objectives. Since the PM has intimate knowledge of the program and has established a long-term relationship with the owner, the PM is normally well suited to this facility management role.

Administrative Close-Out

The PM's responsibilities for administrative close-out relate to demobilizing the program team and completing activities with other stakeholders, arranging the disposition of program records, closing of funding and financing agreements, and performing an evaluation of program success and lessons learned. The PM should follow the procedures and actions specified in each contract's terms and conditions to settle and close the project's design and construction contract agreements. The PM will need to work with the owner's finance staff to close out the funding to the program or projects. The PM should also review the PMP so that all elements of the program are complete.

Program Evaluation

Before the program is over and key program staff has dispersed, it is desirable for the PM to hold a "lessons learned" session. The lessons learned should focus on identifying program strengths and weaknesses with recommendations on how to improve future performance of projects. The program evaluation typically covers the entire architectural, engineering, procurement and construction performance, as well as the post construction phase. It should include evaluation of the Program Management staff performance. Additionally, the program evaluation could include a post occupancy evaluation by formally evaluating certain features and/or the operations of the completed facilities to determine whether modifications should be made to the design for future projects.

Chapter 9: Sustainability

Introduction

This section discusses the expanding subject of sustainability as it pertains to the role of the CM. It outlines in general terms key goals, philosophies and elements of sustainability. The general philosophy is to be incorporated with other key elements of the construction management plan including cost time and quality management as well as within the Project Management Plan.

Definitions

USGBC

The U.S. Green Building Council is a non-profit organization devoted to shifting the building industry towards sustainability by providing information and standards on how buildings are designed, built and operated. The USGBC is best known for the development of the Leadership in Energy and Environmental Design (LEED®) rating system and Greenbuild, a green building conference.

LEED

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.

GBI Green Globes

Green Globes is a green management tool that includes an assessment protocol, a rating system and guide for integrating environmentally friendly design into both new and existing commercial buildings.

Sustainable

The condition of being able to meet the needs of present generations without compromising resources for future generations.

Building Commissioning (Cx)

The startup phase of a new or remodeled building. This phase includes testing and fine-tuning of the HVAC and other systems to assure proper functioning and adherence to design criteria. Commissioning also includes preparation of the system operation manuals and instruction of the building maintenance personnel.

Life Cycle

The consecutive, interlinked stages of a product, beginning with raw materials acquisition and manufacture and continuing with its fabrication, manufacture, construction, and use, and concluding with any of a variety of recovery, recycling, or waste management options.

Pre-Design Phase

Establishing Project Sustainability Goals

The CM should work with the owner to establish the sustainability goals and objectives on the project. Setting the project's sustainability expectations is an important first step to ensure alignment of the expectations with the roles and responsibilities of the project stakeholders. The CM should include the sustainability objectives, team responsibilities and sustainability procedures in the Project Sustainability Plan. The CM must have the necessary experience and qualifications to support the owner in this effort.

Project sustainability goals must be developed prior to start of design, including the decision whether the project will be registered with the USGBC.

Contract Development

As the CM works with the owner's legal counsel in developing the contract for the design team, appropriate language should be recommended related to the sustainability goals to be achieved by the design.

Project Procedures Manual

The Project Procedures Manual developed by the CM should address the procedures related to sustainability, for all phases of the project. The Project Procedures Manual should define the procedures necessary to assure that the sustainability criteria are achieved during each phase of the work as well as the roles and responsibilities of project participants.

Project Commissioning Plan

If the independent commissioning agent is employed by the construction management team, it is the CM team's responsibility to develop the Project Commissioning Plan. If the independent commissioning agent is employed by others, the CM should ensure the Commissioning Plan is initially created prior to the start of design. In either case, the Commissioning Plan must be in concert with the Project Sustainability Plan and the sustainability requirements of the owner. The CM should review the plan to ensure it is readily applicable and enforceable. It should be reviewed for consistency with the master project schedule and overall project goals and objectives. The project goals and objectives and the commissioning plan should be reflective one of the other.

Pre-Design Project Conference

The CM should include the project sustainability champion, the sustainable design professionals and the commissioning agent as a part of the pre-design conference. The Project Sustainability Plan should be reviewed including the sustainable goals and objectives to be met during the project. Roles and responsibilities regarding project sustainability should be clearly defined and reviewed.

Design Phase

The owner and the CM should agree on the detailed scope and number of sustainability reviews required. The CM should also coordinate life cycle analysis, alternative studies, and energy usage analysis. The CM should establish and regularly review sustainability goals, LEED and/or GREEN GLOBE standard targeted for achievement on the project.

Procurement Phase

Projects requiring certification with the USGBC or GBI should include appropriate requirements within the bid documents. If the owner and designer choose NOT to have the project formally registered with the USGBC or GBI but intend for it to be a LEED or GREEN GLOBES equivalent project, appropriate requirements must also be defined within the bid documents. It is the designer's responsibility to include the specific sustainable requirements to be achieved by the contractor. These requirements should be specifically called for in the contract drawings, specifications and/or BIM. The bid documents should also include minimum sustainability related qualifications of bidders.

Meetings

Sustainability should be discussed at the pre-bid meeting. It should specifically be noted whether the project is to be a GREEN GLOBE or LEED certified project and if it is, what is required by the contractor to ensure the specified level of certification is attained and qualifying experience of the bidders. The CM should assist the owner with review of the bids received, including a review of qualifications of bidder relative to GREEN GLOBES, LEED and/or sustainability experience and qualification requirements in the bid documents.

Construction Phase

Pre-construction Conference

If a project is registered with the USGC as LEED certified or greater, or with GBI for a specific number of GREEN GLOBES, it is recommended to have a separate pre-construction conference with the contractor to ensure a clear understanding of the sustainability documentation requirements as the project progresses. If a project is not registered, it is still recommended that responsible environmentally sustainable construction practices be reviewed with the contractor. At this time, the contractor should present to the owner's team the general approach to the project, identifying what sustainable construction practices will be employed.

Construction Planning and Scheduling

The schedule submitted by the contractor should include a series of activities related to sustainability. If the project is registered with the USGBC as LEED certified or better, or GBI GREEN GLOBES, more project activities and or longer durations to allow for monitoring and documentation should be expected.

Inspection and Testing Consistent with the Project Commissioning Plan (PCP)

The CM should verify through inspection of the contractor's work, preferably on a daily basis, to determine whether or not the work is being performed in accordance with environmental codes and regulations, the PCP, the contract documentation and, where applicable LEED or GREEN

GLOBE credit criteria. If the CM is providing such services, these services should be defined in detail.

Reports and Recordkeeping

The CM should maintain thorough documentation of all environmental measures employed on the project. This includes but is not limited to: waste recycling, waste reduction, emissions mitigations, noise and vibrations mitigations, dust reduction efforts, etc. When a project is to be LEED or GREEN GLOBE certified and it has been defined contractually that the CM is to organize the required documentation s/he shall request the required documentation from the GC at the earliest point in the project. If an independent commissioning agent is to be employed by the CM all related documentation should be compiled by the CM throughout the life of the project most notably during the construction phase. If an independent commissioning agent is employed by the owner, the CM should ensure the Cx agent is furnishing the appropriate paperwork in a timely fashion.

Sustainability RFI's or USGBC Credit Interpretation Requests

When a project is specifically determined to be sustainable (striving to achieve specific sustainable goals), requests for additional information or in the case of USGBC registered LEED 'to be certified projects' may require credit interpretations. A system/procedure must be in place in order to vet these requests. The traditional RFI approach may be appropriate depending upon the complexity of the sustainable applications. This should be discussed and agreed to at the pre-construction conference.

Post-Construction Phase

GBI or LEED Application Process During the Post-Construction Phase

The CM's responsibility is to assure the contractors have provided all documentation necessary for certification and/or required by the contract and that the Contractor and CM assigned responsibilities have been met. The GREEN GLOBE or LEED application will be submitted by the party designated as the agent for the project. This could be the CM, GC, designer or the project's sustainability champion.

LEED/GREEN GLOBE Review Process

Upon receipt of the preliminary GREEN GLOBE/LEED Review document noting the credit achievement anticipated, pending, and denied, the designated responsible professional will call a meeting with the designer, contractor and owner to review the comments with the team to establish an action plan to resolve all open issues.

Training Sessions

If specific sustainability elements were installed as a part of the project, appropriate training should be specified in the contract documents. Prior to closeout this training should be completed. The CM should confirm that the training is available to the appropriate facilities management personnel as well as the owner. The training should include an introduction reiterating the sustainable goals and objectives of the project.

Final Owner Sign-off

Final owner sign-off should only be recommended once all the requirements as defined in the Project Sustainability Plan, and included in the construction documents are completed and verified.

Chapter 10: Risk Management

Introduction

Risk (n.) A Source of danger; the possibility of suffering harm or loss.

In the context of design and construction, risk management is the process to methodically address risk and work to lessen the impact of the occurrence of risk events on a project or program in all phases of development. Opposite of risk are opportunities which if acted upon have the potential to reduce overall projects/program (referred to hereafter as “project”) cost and schedule and or improve quality.

Risk management is inherent in any business enterprise including that of the owner and Construction Manager (CM). Although the A-Series CMAA Standard Forms of Agreement only imply a nominal risk management role for the CM, administration of contracts, which contain insurance requirements, waivers, bonds, liquidated damages, claims and indemnity provisions are subjects of risk management.

The owner’s reliance on the CM for risk management services varies greatly. The intent of this document is to provide the CM with a guide to a standard implementation of risk management on a project.

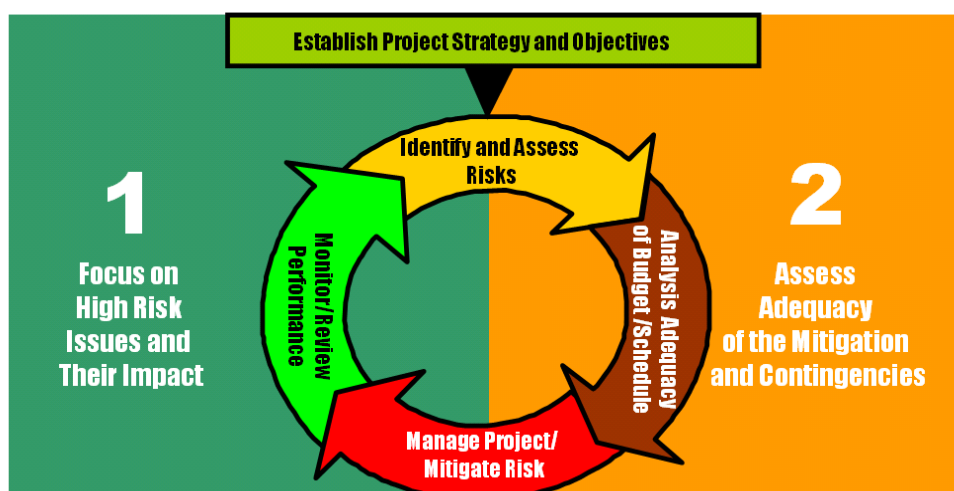
The objective of risk management for construction projects and programs is to provide a process for the early identification of risks and opportunities in order to allow them to be tracked and managed throughout the project. Risks may be transferred from an owner to a third party, mitigated with various forms of project insurance and minimized or eliminated through design and engineering. Risk is known to be inherent to major capital construction projects. Although some risk events are unpredictable, other risks can exist in response to the actions and decisions that are made when planning the implementation of a project. For purposes of this discussion, we will focus on planning for the mitigation of risk consequences, which are defined as potential losses, damages, or any other undesirable events – including the loss of opportunities.

In addition to reviewing project scope, cost and schedule to identify risks and opportunities to be managed throughout the project, the CM also has the task of reviewing project contracts for potential risks and liabilities, and reviewing legal requirements in the contracts to determine the potential impact of contract clauses and developing a plan to address these potential impacts.

Risk management

Risk management and planning begins in the early phases of project development. Recognizing the need to apply risk management processes during the pre-design and design phases is often critical to effective project development on large and complex projects. All construction project plans are based on estimates that contain uncertainty. Often the larger or more complex the project, the more severe the risk consequences can be. One issue with planning capital construction projects is the magnitude of uncertainties that exist. Where there is uncertainty, there is also risk of unfavorable consequences. The best method for dealing with these uncertainties and the associated risk consequences is to develop and implement a risk management process as part of the Construction Management process. A structured risk management methodology should be one of the key management processes integrated with the project management applications receiving the same level of attention as budget control and scheduling, decision-making, and claims avoidance. Controlling risks should not be an arbitrary function that is separate or apart from other project management applications. Risk management is expected to be a continuous process on projects and be integrated into the project management processes.

Figure 1: Continuous risk strategy and management



An iterative and continuous process for managing risk as it changes and shifts.

Figure 1 illustrates the overall objectives of a strategic risk management process. The first step in risk management strategy is acknowledging that the potential for risk consequences cannot be completely eliminated, but can be mitigated. Major capital construction projects are commonly faced with all types of risk events, such as adverse weather, differing site conditions, required or desired scope changes, unavailability of specific types of resources, unanticipated environmental factors, or community pressures. The adverse effects associated with these events are normally manifested in the form of increased cost, re-sequencing of construction activities, and delays that have the potential to interfere with successful project delivery.

CMAA has defined five major phases of project and or program development: 1) Pre-Design, 2) Design, 3) Procurement 4) Construction and 5) Post Construction.

Risk management meetings should be held during each of these phases to help the project team identify and focus on the risks that can be managed within a particular phase. The risks are also typically categorized as emanating from within the control of the project team or external to the project with minimal control from the project team. The risk management process should start at the very beginning of the project with development of a *Design and Construction Risk Management Plan*, which details the processes planned for assessing, mitigating and managing the potential risks. The plan should contain a statement of purpose for risk management process and the overall project performance objectives to be achieved.

The *Design and Construction Risk Management Plan* should also summarize key definitions of risk terminology, establish program and process policies, and identify each stage of the process. More specifically, the plan should document the risk identification and mitigation methods to be used. This plan in itself should help guide the project team's overall understanding of risk management processes and help create personal connection and commitment for using the risk management methodology.

The risk management plan generally includes the following major steps:

1. Risk Identification
2. Risk Analysis
3. Risk management

Each of these implementation steps should be followed by the CM during each project phase. The following are some specifics to each phase that the CM should consider in the review and the minimal suggested involvement for input during the risk meetings:

1. **Pre-Design:** Review of the design concepts and studies, potential external challenges or deterrents to the project, funding, schedule, community impact, etc. The review should include the CM, owner, designers and other project stakeholders.
2. **Design:** Review of the construction plans and specifications, proposed schedule, estimated costs, utility relocations and coordination, environmental mitigation, land purchases or issues, permitting, constraints, access, etc. Prior to advertising for bids, review of construction contract language with special emphasis on the appropriate allocation or mitigation of identified items of risk and the potential impact to scope, cost and schedule. The review should include the CM, owner, designers, as well as construction representatives if possible.
3. **Procurement:** Review questions from bidders for possible unidentified issues or risks, adequacy of number of bidders, and necessary addenda.
4. **Construction:** Review previously identified risks throughout construction to assure they are appropriately managed, review unforeseen conditions or other risks not previously identified, and potential construction change issues affecting scope, cost and schedule. Should include CM, owner, designer, contractor and other representatives with input to critical construction issues.
5. **Post Construction:** Review of warranties, maintenance and operations plan, and any outstanding construction items and potential claims. Should include CM, owner, operations and maintenance personnel, and contractor representative (if necessary).

The following describes services the CM should typically provide a client for these major risk management implementation steps. The CMAA Procedures /Guidelines for risk management provide more detail on the recommended methods for carrying out these steps.

Risk identification

Risk identification is the process of evaluating the project to be constructed and recognize the possible risks that could impact the project, typically related to scope, cost and schedule. Many risk managers, consultants, owners and insurance companies have lists, survey and audit forms, and other means of collection and documenting the risks on typical projects. Some important items in the identification of risk include:

- Realistic project assumptions – View the project assumptions realistically. Do not allow the project assumptions to be interpreted too idealistically, and promote the thinking that all will go according to plan.
- Gather expert judgments – Collect a spectrum of expert judgments, which supports unbiased assessments and analysis.
- Clearly understand risk elements and their impacts – Clearly understand the elements of risks and their potential impacts in the early phases of project planning and development.
- View project realistically, not idealistically - For an effective risk management strategy, the expected results of the project, in terms of cost and schedule, must be objective and realistic.

The CM should be the facilitator in organizing teams to assist in identifying risk as early as possible on a program, with the first meetings being held late in the pre-design phase. Continued discussion on identifying, analyzing and managing risks should be held at each of the project phases.

Figure 2: Overall strategy of the risk management program



Employing risk management processes to help attain success and meet expectations.

Figure 2 illustrates the importance of the strategic risk process and risk identification to ultimately minimize the impact of risks and maximize any opportunities that are identified.

Risk analysis

The identification and logging of the risks and opportunities is only the beginning of the risk management process. Once the risks and opportunities for the project are identified, they can then be analyzed to provide the project team and stakeholders with a structured assessment of the potential for the risk to impact the project. This allows the team to focus on those risks that are considered to have the most likely chance of occurrence with the greatest potential project impact. An example of the qualitative portion of this evaluation is the following:

Figure 3: Risk Evaluation Scoring Criteria

RISK EVENT STATUS

SEVERITY	CRITICAL	SERIOUS	MAJOR	MAJOR	CRITICAL	CRITICAL
	MAJOR	MODERATE	SERIOUS	MAJOR	MAJOR	CRITICAL
	SERIOUS	MODERATE	MODERATE	SERIOUS	SERIOUS	MAJOR
	MODERATE	MODERATE	MODERATE	MODERATE	SERIOUS	SERIOUS
	MINOR	MINOR	MINOR	MODERATE	MODERATE	SERIOUS
		MINOR	UNLIKELY	POSSIBLE	LIKELY	ALMOST CERTAIN
		LIKELIHOOD				

Figure 3 is developed based on input from the project team who are most familiar with the risk potential, and risks are evaluated (or scored) based on the likelihood that the risk will actually occur and the severity of the impact on the project should it occur. Note that in this qualitative review; no figures are estimated, but the matrix of likelihood and severity results in the project team being able to categorize risk from “Critical” to “Minor,” providing a guide to help identify where to devote time to project risks. As the CM moves the team into the quantitative stage, figures are estimated for severity and percentages are estimated for likelihood to better define potential risk impacts.

The CM must be instrumental in ensuring that after all of the risks are identified they are analyzed to determine their potential impact on the project. The risks are also analyzed to determine who on the project team can be assigned to follow-up on action items related to each risk, that then become part of the risk management plan.

Important points of the risk analysis include:

- Assess and analyze risks impacts – Complete the evaluation and analysis of particular risks to the point of determining the impacts they will have on the project goals and objectives.
- Complete mitigation and contingency plans – Fully develop mitigation and contingency plans sufficient for the degree of impact associated with the risks identified.
- Synthesize the risks – Synthesize all construction risks and determining the total cumulative effects.

Risk management

Once the risks and opportunities have been identified and assessed, the knowledge and information gathered is utilized to properly manage them. The CM should ensure that a structured process is followed through all project phases to ensure that risks and opportunities are managed to avoid unnecessary risk impacts and realize the potential opportunities. The following are four essential components of the risk management process.

Communication & Reporting

Utilizing the project risk database that includes all of the risks and opportunities identified, the CM holds project team meetings to communicate the risks/opportunities and collect feedback, updates and other related information. Reports are sent to internal project personnel based on those who should be aware and are in the best position to act to mitigate the risks and or achieve the opportunity.

Tracking

With each update from the project risk meetings, the risks/opportunities are tracked and adjusted, based on input from the project team. Additions to the list are added as they become known. Risks/opportunities maybe retired if the project team considers there is no longer a potential for the risk/opportunity to impact the project. The tracking must be updated and communicated consistently to maintain a focus on the priorities of the project team.

Mitigation

Possibly the most important part of the risk management process is mitigation. As the risks are first identified, a member of the project team is given the primary responsibility for the risk. This entity or individual would have the most opportunity to work towards mitigating the risk and minimizing any impact to the project. The assignee is responsible for providing a risk mitigation plan. This plan is a set of action items with responsibilities and required dates, with the intent that these actions enacted by those responsible will provide the best possibility of mitigating the risk to reduce the impact to the project.

Resolution

As the mitigation plan is put in place, action items are completed, and decisions are made related to the project, the project risks come to a resolution. The risk can be avoided or eliminated, mitigated, transferred or deferred, or become a reality (with an impact to the project). As the risks come to resolution, the risk data is updated to include the results, along with notes related to the resolution and any “lessons learned” related to the risk.

Figure 4. Relationship Among Project Risk Management Stages

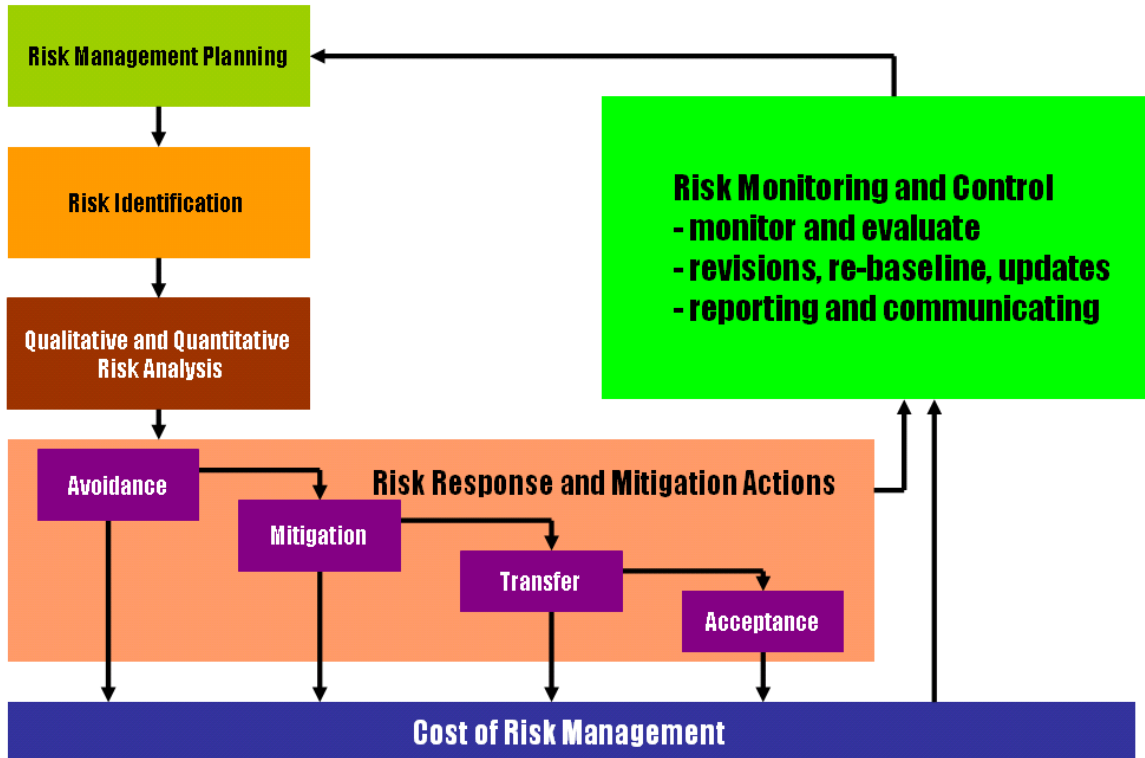


Figure 4 documents the risk management process described previously. It documents the flow from the risk management planning, to risk identification, to risk analysis, culminating in a resolution where the risk is avoided, mitigated, transferred or accepted, ultimately with the impact on the project being assessed. Thoroughly documenting this risk management process in the risk log allows for the continued interface of the risk with the other project control tools including budget and schedule management, for reporting and communicating and for keeping the log for future similar projects and sharing “lessons learned.”

Continuous Evaluation of the Risk Effects

Any project can expect to continue to face numerous potential impacts compounded upon the already identified risks. As the capital project transitions into the implementation phase of procurement and construction, the risks can change; therefore, risk management cannot be looked upon as an independent function, but rather it should be planned from the beginning as an integrated part of the owner’s Construction Management process. There can be many risks outside of the control of the project team that have the potential to cause impacts if not continually monitored. The project owner should have an ongoing integrated process for risk management based on sound fundamental principles. As conditions change, the CM on behalf of the owner should have a process in place for implementing new mitigation strategies and options as project conditions change.

A continuous integrated risk management process will help reduce the potential for unidentified negative impacts, will improve the CM's continuous efforts of obtaining consensus, continue coalition building, and maintain a steady focus on the project's constraints and objectives.

Conclusion

A careful review by the owner and the CM of their respective risk management capabilities will allow for understanding of their optimum roles which must be articulated clearly in the CM contract scope. As is the case with safety, the CM should be familiar with all of the legal implications and responsibilities of providing risk management services. If neither party possesses the required skill set, an outside risk management consultant with construction expertise should be retained by the project team.

It is not reasonable to think that risk can be eliminated from construction projects. However, risk events can be acknowledged much more explicitly and managed a great deal better with more accountability than is typically the case. The challenge is to recognize risk, decide what to do about it and manage it. To enhance project delivery and performance, an integrated risk management process should be one of the tools used with the construction management applications. The benefits of the risk management process are expected to include:

- Provide a disciplined framework for systematically guiding the process of identifying and managing risk that may not otherwise be considered;
- Helps avoid/reduce large losses and lessens the frequency of smaller losses;
- Helps identify opportunities that become realities and enhance the project delivery
- Improve decision making through clarifying responsibilities and authorities; and
- Support a better understanding for managing risks leading to increased project confidence and improved allocation of resources.

Chapter 11: Building Information Modeling (BIM)

Introduction

BIM is a process by which digital representations of the physical and functional characteristics of a facility are captured, , analyzed, documented, and assessed virtually, then revised iteratively through the design and construction process. The model continues to evolve in the construction phase to analyze and communicate the building process in a virtual environment, including sequence of work, means and methods, logistics and documentation of as-built conditions. The process then continues throughout the lifetime of the facility with the model serving as a shared knowledge resource for information about a facility that forms a reliable basis for decisions during its lifecycle from inception through design to construction, occupancy and operations.

A building information model may be best described by its key features such as 3D parametric modeling, engineering analysis, clash detection, 4D schedules, quantity take-off, and general information assignment (including specification or product data linkage).

The design and construction industry is currently addressing the impact of BIM on the traditional project delivery processes. Given the ongoing BIM evolutionary process, the role of a Construction Manager can vary significantly based on the extent of adoption of the BIM process by the owner and the project delivery team, the Construction Manager's contractual obligations, and owner expectations. It is also likely that the Construction Manager's role will continue to evolve and change as the BIM process matures. This standard of practice is written so as to maximize the role of the Construction Manager in the BIM process, consistent with the CM's traditional role on a project, and to afford the CM the opportunity to lead the overall process as it continues to evolve.

The Construction Management profession is in a position to deliver many of BIM's benefits through implementation of the virtual construction techniques without significant modifications to the current business models. The CM is the central information hub for the project and as such is in the best position to manage the high value BIM process.

The SOP below provides a brief summary of the CM's role and responsibilities in implementing BIM on a project by phase. The CM must also accept the following general responsibilities related to the BIM process:

The CM has the responsibility to stay current and remain educated on the BIM process.
The CM has the responsibility to educate the owner and the project team on the benefits, features, limitations and the implementation process for BIM.

By educating its own personnel and the rest of the project team, the CM has the opportunity to continue its leadership role in the project delivery process with appropriate application of BIM.

Definitions

3D parametric modeling

3D modeling is a superior design environment when compared to traditional 2D CAD. 3D modeling applications have the ability to capture design intent parametrically, which facilitates model creation and editing and therefore reduces the likelihood of coordination errors. Although preparation of the 3D model may be a significant part of most BIM efforts, a model alone does not constitute BIM. The 3D model, however, is a great tool for visualization of the design to benefit the project team and the project.

Engineering Analysis

At the core of BIM lies a digital database in which objects, spaces, and facility characteristics are defined and stored. These characteristics make it possible to use BIM as a virtual representation of a physical facility, and hence, capable of supporting qualitative and quantitative analyses. These BIM-enabled analyses, whether for structural, energy consumption, daylight analysis or a number of other performance simulations, can significantly enhance the efficiency and efficacy of the design, planning and building processes.

Clash detection

Since the 3D model represents virtual true space, a BIM process known as “clash detection” can be utilized to check for interferences by searching for intersecting volumes. It is often the case to use a third party application not only to clash a single model but combine and clash multiple models from disparate sources in a common environment.

4D Schedules

A 4D BIM scheduling application can dynamically link the project CPM schedule activities to 3D objects in the BIM model. This allows for a graphically rich and animated representation of the planned construction sequence set against time. 4D schedules are a powerful tool for phasing, coordinating and communicating planned work to a variety of audiences including project stakeholders and those directly responsible for executing the work. These schedules also support simulated what-if scenarios.

5D Cost Management Capabilities

Every element in the BIM model can be attributed to what it will actually represent in terms of resources and respective costs. This capability will allow a parametric and dynamic quantity take-off for bills of materials, which will result in a more accurate estimate and therefore less time spent by the estimators on the quantity take-off and more time spent on performing cost estimate analysis.

BIM Integrator

The BIM integrator is a role needed when BIM is implemented with certain delivery methods, in particular, the traditional Design-Bid-Build. The BIM integrator role can be assigned to the architect/engineer, builder, CM or another independent party. The main responsibilities for the BIM integrator role are:

- Ensure a smooth transition of the model from the design to the construction phase.

- Maintain a central model at all times and incorporate the latest available information from multiple project participants.
- Bring new project team members, (subs, vendors, etc) up to speed on the BIM project objectives and current model status.
- Ensure a complete and thorough transition of the model from the construction phase to the owner.
- Verify, in all the project phases, that the model meets the owner's BIM requirements and the project BIM specifications.
- Assure interoperability between models on those projects where a multiple model approach is unavoidable.

Pre-Design Phase

Establishing BIM Goals & Objectives

The CM shall work with the owner to establish the goals & objectives of using BIM on the project. Project BIM expectations and the team BIM qualifications shall be set as early as possible to ensure alignment of the expectations with the BIM roles and responsibilities among the project stakeholders.

The goal during this phase is for the owner to establish a clear understanding of the BIM scope of work, phases of implementation, team responsibilities and expected outcome. The CM shall educate the owner on the BIM process and promote its appropriate use. There also needs to be a clear understanding of any implications that might affect the project as well as the shortcomings of the BIM technology as it is related to the project.

The CM shall include the BIM objectives and team responsibilities in the Construction Management Plan.

Selection of the Design Team

If it is established in the Construction Management Plan that BIM will be used in the execution of the project, the CM shall include the BIM experience of the design team in BIM and their implementation approach among the selection criteria in the Request For Qualifications (RFQ). The CM shall market the project to the design community and seek design teams with BIM experience to propose on the project. During the RFQ review and interview process, BIM capabilities of the design teams should be given appropriate weight, depending on the importance of BIM for that project in the selection criteria. BIM scope of work shall be defined and made clear to the designer and all the members that will be joining the team thereafter.

Contract Development

As the CM works with the owner's legal counsel in developing the contract for the design team, appropriate language shall be recommended related to the use of BIM by the design team and the availability of the model created by the design team to other project team members, including the CM and the construction team. The contract also needs to address the structure or format of the BIM, including the level of detail and allowable use of 2D detailing. Contract shall also address the use of BIM by structural, civil, MEP and other subconsultants.

Project Procedures Manual

The Project Procedures Manual developed by the CM shall address the procedures related to BIM for all phases of the project. The Project Procedures Manual shall establish modeling criteria for BIM so that the model can be used for all the project BIM objectives. This may also be a stand-alone document rather than part of the Project Procedures Manual. If it is a separate document, the Project Procedures Manual shall integrate the requirements of this document.

BIM standards for the project shall be developed and included in the design contract and further expanded in the BIM procedures. BIM distribution and access protocols shall be clearly defined in the procedures. BIM procedures that impose requirements on contractors must be coordinated with bid and contract documents.

Model Development by the CM

It will be in the best interests of the project if the design team adopts the BIM approach to development of design documents and the construction team uses BIM in their construction approach. However, if this is not the case, the CM shall consider developing the model itself and providing its services using this tool. Depending on the project, the CM may be able to develop a model to create budget and detailed estimate, 4D scheduling, constructability reviews and specific site logistics and coordination issues. Adoption of this approach will depend on the type and size of the project, the cost and level of detail of the model and the resulting benefit of the model. If the development of a detailed model for the complete project by the CM is not a good investment, the CM shall explore modeling portions of the project to achieve specific, relevant functions that can enhance the success of the project with a positive return on investment.

BIM and project delivery systems

The CM shall recognize that the application of BIM varies significantly based on the delivery system chosen. Use of Design-Build approach maximizes the chance of collaboration between the designer and builder using the model. Use of CM-at-Risk with the possibility of major subcontractor providing design assistance during the design phase also enhances the use of BIM as a collaborative tool. The traditional Design-Bid-Build process may limit the interaction between the designer and builder with the model until construction starts; in this case the BIM integrator role is a key to the success of the BIM implementation. The delivery system will also influence the adoption of BIM on a project. The Construction Management Plan and Project Procedures Manual will also be significantly different as related to BIM implementation, based on the delivery system.

Design Phase

Compliance with BIM standards

As defined in the pre-design phase and the designer or design-build entity contract, the CM shall conduct a 'BIM kick-off' meeting to further clarify and agree on BIM standards and implementation procedures on the project. Periodic design review meetings must address and monitor compliance with established BIM standards. Design milestone submittals (such as schematic, design development, construction documents) must be reviewed for compliance with established BIM standards.

Design Document Review

The CM and the designer or the design-build team shall utilize the BIM model to perform multiple design reviews. The model can be used to assist in compliance with design criteria and to perform

and facilitate multiple group review meetings. Using the BIM model for design review will help the team visualize the spaces and functions, optimize the design and facilitate the decision making process. The CM shall take full advantage of the visualization benefits of the BIM so that the Owner, user groups and other stake-holders can see their project virtually and minimize the potential for changes after the building is constructed.

The model should be used to perform clash detection and facilitate coordination between all design disciplines. During design reviews, “virtual hardhat reviews” could be done; this is a virtual walk through the model to examine and review jobsite logistics and the facilities being constructed or renovated. ‘Clash detection’ exercises shall also be performed by the designer, CM or a third party to identify physical conflicts, spatial constraints and to facilitate better coordination among various disciplines.

Document Control

Document control protocols should be established in the pre-design phase. Document control is a very important part in a BIM designed project, due to the likely existence of multiple database structures. The CM (or the BIM integrator, if different than the CM) shall be responsible for document control and should ensure that everyone on the team follows the document distribution and other document control protocols. These protocols must also define procedures for accessing and manipulating BIM model(s). If any revisions to the document control protocols are identified, the CM is to ensure that the BIM procedures document is updated.

Contracts/Agreements

See Procurement section.

Public Relations, Community Outreach and Buy-In

Using the BIM model and creating phasing and 4D simulation, the CM shall assist the Owner in public relations activities, particularly to communicate the project with the community and with parties that will be impacted by the project.

Cost Control

Depending upon the BIM objectives established for the project, the CM should attempt to maximize the use of model based budgeting and estimating. On projects that require the development of design fully utilizing BIM processes, the CM shall collaborate with the design team to define model development criteria to enable development of model based estimating. To benefit most from the model, the cost structures could be developed earlier than in a conventional project. The model based budget and estimate can be used for options analysis and value engineering, including exercises to modify the design to match the budget, as needed.

Procurement Phase

Influence of Delivery Method

The bidding process and the use of BIM will change significantly based on the delivery method. The CM shall be knowledgeable about the application of BIM in the procurement phase for the various delivery methods.

Bidding and Contracting Process

Bid Documents

Building Information Models developed by the design team should be formally included as part of the procurement documents. This approach provides the responders with the maximum information available to facilitate their full understanding of the project. If the owner and designer choose not to include the modeling documentation formally as part of the procurement documents the CM should encourage their use as reference documents, with proper delineation of order of precedence of the information provided.

Contracts/Agreements

Ideally, the CM should encourage the owner to have the BIM requirements written into the contract documents. Typically, this would have been established in the Construction Management Plan. When the Construction Management Plan incorporates full BIM implementation, the CM shall verify that the model and all its parts or sub-models and databases are required to be updated and revised to reflect as-built conditions. The contract should require that as-built documented models and databases be linked together and submitted at the end of the project. Training on how to access information from updated model must be included as part of the contract.

Pre-Bid or Pre-Proposal Meeting

The CM shall use the model to communicate the project to the prospective bidders or proposers at the pre-bid or pre-proposal meeting and to facilitate generation of comments and questions by contractors prior to submission of bids or proposals. CM shall also highlight and explain the BIM requirements of the project.

Marketing of the Project

The CM shall market the project in general and generate interest from the entities that are well versed in the BIM process in order that qualified entities with extensive BIM experience and knowledge participate in the procurement phase.

Selection of Contractor(s), Design-Bid-Build, CM at Risk or Design-Build

In the case of a Design-Bid-Build process, the CM can use the pre-qualification process and incorporate BIM experience as one of the factors. After bids are received and evaluated, a pre-award conference with the apparent low bidder shall be held. The CM shall verify the capability of the contractor to comply with the BIM requirements of the project articulated in the contract documents.

In the case of a Design-Build or CM-at-Risk delivery process, the selection process likely will include review of written proposals and interview(s). The CM shall play a central role in reviewing the proposals for compliance with BIM requirements. In the interviews, the CM needs to ensure that the approach and capabilities of the entities related to BIM are clearly articulated and are considered as one of the factors in the selection.

Construction Phase

Transitioning the Model to Construction

The CM (or the BIM integrator, if different than the CM) shall work closely with the construction phase team to transition the model to the construction phase, using the document control protocol (see Design phase).

During construction, the CM shall facilitate proactive participation of stakeholders including owner/operator, designer, contractor, subcontractors, suppliers, equipment manufacturers and system integrators as well as select third parties such as building official(s), local utility companies, insurers, sureties and other stakeholders. The CM should ensure that the responsibility for updating each model and all requirements from the above listed team members must be clearly defined in the scope of work and the contract language.

On-Site Facilities

Construction administration has been considered the final stage of design, when issues are addressed and solutions are devised for field-encountered problems as well as revisions in the scope of work. The CM should encourage the full use of the BIM to address problems and facilitate solutions. To facilitate this capability on projects of appropriate size and complexity, it is recommended to have an available on-site model and a designated BIM integrator who will monitor and update the model as the project moves forward. Availability of a ‘virtual plan room’ will also significantly enhance the use of BIM for construction.

Coordination

The contractor, CM-at-Risk or design-builder is responsible for project coordination throughout construction. Regardless of project delivery method, the builder should be contractually obligated to use the model to ensure project coordination. This would include revising the model based on existing conditions, incorporating information from subcontractors’ shop drawing submittals, and clash detection. The role of the CM is to ensure and encourage the full use of the BIM tool in coordination and issue resolution.

Time Management

Use of the 4D model is a great tool in time management. The CM needs to encourage its use by the builder. It will also be prudent for the CM to develop a project specific 4D model based on the project BIM. The construction schedule can be tied to the model to allow visualization of deviations from planned sequences and durations. This practice should be incorporated in the periodic progress review process. In order to accomplish this, the CM needs to establish the protocol through the contract documents or procedures manual.

Budget & Cost Monitoring

The builder has the opportunity to use the BIM for the cost management of the project. The opportunities for the CM to use BIM for cost management during construction are limited. Some of the opportunities for using the model in cost management are discussed under change orders.

RFIs, Submittals & Shop Drawings

The CM should encourage the use of the model to produce shop drawings. Such requirements must be defined in the contract documents and implemented. The review of the shop drawings can be done by the design team by reviewing the model submitted by the builder. The extent of such extensive BIM implementation needs to be defined as early as the Construction Management Plan, articulated in the designer’s and builder’s (or design-builder’s) contract documents and project procedures. Further the CM needs to verify that there is buy-in to the full implementation by the stake-holders to maximize the chances of success. Use of the model for RFI review can be very effective by helping the design team visualize the conditions related to the RFI.

Change Orders

When reviewing and pricing the change orders, the BIM can provide the CM with a great tool to visualize the change by viewing the model. The responsibility for documenting the change orders on the model must be clearly articulated and generally should be placed with the builder. The CM shall verify such incorporation, similar to their role in verifying the posting of the changes to the as-built documents.

Owner-Purchased Materials and Equipment

If during construction additional components, materials and/or equipment supplied by the owner are installed, the model shall be updated by the builder or BIM integrator to include the owner-purchased designation. Quantities and schedule of values for the materials can be extracted from the BIM model for an accurate count and to save time.

Record Model

The CM must monitor that model updates are done throughout the construction phase and, if required by the owner, the model evolves into an as-built model for record purposes. It is also possible that the builder may start its own model, rather than build upon the model produced by the designer. Irrespective of the approach, the CM shall ensure that contract language is clear on the entity responsible for updating the model as an as-built document and on the desired level of detail. Further, the CM needs to monitor compliance to verify that the owner receives a proper as-built model at the end of construction, in accordance with the contract requirements.

Post Construction Phase

Transitioning the Model to the Owner and Facility Management

The CM shall ensure that the model is transitioned to the owner at a minimum as an as-built model developed through the design and construction process. Such model can provide benefits to the owner related to facility management, such as space planning related to occupant assignment, furniture and equipment inventory etc.

On the other hand, a model that can be transitioned to the facility management is of most value to the owner. Such model is highly dependent on the owners' facility management systems and their current operations and maintenance processes and procedures. The CM needs to work closely with the owner's facility management team and the project team to define what the facility management team wants and needs from the model and in what format will the information be useful for future use.

During the post construction phase the CM shall continue to work collaboratively with the stakeholders including owner/operator, designer, contractor, subcontractors, suppliers, equipment manufacturers and system integrators. Responsibility for mastering the as-built, and/or facility management (BIM) model resides in the office of the facility's operations. This includes managing and updating the model. The CM shall also manage the proper training for the owners and the facility operators.

Maintenance Manuals and Operating Procedures

The software technologies are being developed to link O&M documentation to the product data that would be linked to the as-built models. As operations personnel need to reference training videos for refreshers, or operating procedural documentation it will be accessible via a BIM link.

The CM needs to stay abreast of these developments and facilitate their incorporation into the project as and when appropriate.

Spare Parts and Warranties

Schedules of spare parts submitted and the related warranties can be input into the as-built model, accessible to the operations personnel. The CM needs to include such requirements in the contract of the builder and verify that it is done or arrange for a third party vendor to incorporate such information into the model. Once this model is transferred to the facility operations personnel, it is their responsibility to keep the inventory of the spare parts schedules updated. These personnel would then be triggered to order new parts accordingly. The responsibility of the CM is to verify that training of the facility operations personnel is included in the contract document and conducted before turning over the facility and the model to them.

Final Permits

The CM should also endeavor to verify that copies of final permits are linked to the as-built model for reference by the operations personnel.

Asset/Facilities Management

Regular inspection, maintenance, and repair logs can be linked to the model to provide an accurate up-to-date history of the facility including equipment and materials.

The CM's responsibility is to stay abreast of the available technology and facilitate implementation appropriate for the facility and the capabilities of the facility operations personnel.

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